REPORT RESUMES

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AN INVESTIGATION OF CLOSED-CIRCUIT TELEVISION FOR TEACHING UNIVERSITY COURSES. INSTRUCTIONAL TELEVISION RESEARCH, PROJECT NUMBER ONE.

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DESCRIPTORS- *CLOSED CIRCUIT TELEVISION, *INSTRUCTIONAL TELEVISION, CHEMISTRY, *PSYCHOLOGY, ACADEMIC PERFORMANCE, *CLASSROOM RESEARCH, EFFECTIVE TEACHING, EXPERIMENTS, COSTS, *COLLEGE STUDENTS, *COLLEGE TEACHERS, EQUIPMENT STANDARDS, TEACHER ATTITUDES, STUDENT ATTITUDES, STUDENT TEACHER RELATIONSHIP, FEASIBILITY STUDIES,

THIS PROJECT COMPARED THE EFFECTIVENESS OF UNMODIFIED UNIVERSITY COURSES TAUGHT VIA CLOSED-CIRCUIT TELEVISION WITH THE EFFECTIVENESS OF THE SAME COURSES CONVENTIONALLY TAUGHT FOR ONE SEMESTER. THE ACCEPTIBILITY OF TELEVISED INSTRUCTION TO STUDENTS, FACULTY, AND ADMINISTRATORS WAS MEASURED, AS WAS THE FEASIBILITY OF USING MODERATE COST TELEVISION EQUIPMENT. GENERAL CHEMISTRY AND GENERAL PSYCHOLOGY WERE USED FOR THE EXPERIMENT. STUDENTS WERE CHOSEN FOR UNIFORM ABILITY, INTEREST, AND PREVIOUS KNOWLEDGE. THREE GROUPS WERE SET UP WITHIN EACH COURSE--(1) RECEIVING CONVENTIONAL INSTRUCTION IN TELEVISION ORIGINATING ROOM, (2) RECEIVING TELEVISED INSTRUCTION, (3) CONTROL GROUP RECEIVING CONVENTIONAL INSTRUCTION. MODERATE COST VIDICON EQUIPMENT WAS USED. OBJECTIVE TESTS ON COURSE CONTENT MEASURED STUDENT ACHIEVEMENT. STUDENTS AND TEACHERS RECORDED THEIR REACTIONS TO TELEVISED INSTRUCTION. EQUIPMENT CONDITION WAS RECORDED. THE DIFFERENCE BETWEEN THE EFFECTIVENESS OF TELEVISED INSTRUCTION VERSUS CONVENTIONAL INSTRUCTION WAS NOT STATISTICALLY SIGNIFICANT, DIRECT PRESENTATION PROVED SLIGHTLY MORE EFFECTIVE. STUDENT REACTIONS TO TELEVISED INSTRUCTION WERE NEUTRAL OR SLIGHTLY NEGATIVE. FACULTY WERE SKEPTICAL BUT WILLING TO EXPERIMENT. ADMINISTRATORS WERE FAVORABLE. MODERATE COST VIDICON EQUIPMENT PROVED ADEQUATE, THOUGH MAINTENANCE WAS A PROBLEM. OTHER APPLICATION AND PROBLEMS OF INSTRUCTIONAL TELEVISION ARE ALSO DISCUSSED. (MS)

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A

Instructional Television Research

PROJECT NUMBER ONE:

EM000506

An Investigation of Closed-Circuit Television for Teaching University Courses

Conducted by The Instructional Film Research Program

THE PENNSYLVANIA STATE UNIVERSITY

Project Sponsored by

The Fund for the Advancement of Education

Instructional Television Research

PROJECT NUMBER ONE

An Investigation of Closed-Circuit Television for Teaching University Courses

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In Collaboration with

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With the Cooperation of the

Departments of Chemistry and Psychology

THE PENNSYLVANIA STATE UNIVERSITY

University Park, Pennsylvania
July 31, 1955

EM 000 506

Objectives and General Conclusions

Objective One: To compare the relative effectiveness of conventional instruction with the same instruction presented over closed-circuit television for a full academic semester.

Relevant Finding: The overall comparative measurements did not yield significant differences in *informational learning* by students in two different courses of psychology and the lecture-demonstrations part of general chemistry.

Objective Two: To study the acceptability of unmodified courses presented to students over closed-circuit television.

Relevant Findings:

(a) Instructional television was *acceptable* to students for the courses as taught in the context of the experiment.

(b) Students' general attitudes towards televised instruction as compared with direct instruction were mainly neutral or slightly negative.

Objective Three: To investigate trends in *effectiveness* and *acceptance* during a full semester of regular instruction.

Relevant Finding: No statistically significant trends in effectiveness or acceptance were found over the course of a full academic semester of televised instruction.

Objective Four: To study the feasibility of using "moderate cost" closed-circuit television for teaching selected university courses.

Relevant Finding: It was found to be practical to use vidicon closed-circuit television equipment under the conditions of the experiment, but there are many problems of *feasibility* and *costs* which need further study preparatory for full scale operations.

Objective Five: To study the acceptance of instructional television by administrators and faculty members.

Relevant Findings:

(a) University administrators accept and see promise in closed-circuit television as *one* means of solving difficult problems related to increased student enrollment, shortages of instructors and limitations of academic space and facilities.

(b) Experienced instructors generally *do not* prefer instructional television, as used in this experiment, to their accustomed teaching procedures.

(c) Faculty members are willing to accept closed-circuit television on an *experimental basis.*

Objective Six: To explore the possibilities of using closed-circuit television to extend the power and influences of good and superior instruction to large numbers of students.

Relevant Finding: Practical use of two systems suggests that the potentialities are very great for using single or multiple systems of closed-circuit vidicon television for channeling excellent instruction from a single source or sources to very large numbers of university students.

This year's exploratory work has helped to define a great number of unsolved problems of instructional television which urgently need investigation.

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I—Introduction and Perspective

1-1 Basic Commitments of Higher Education

Colleges and universities of the United States have basic, heavy and increasing commitments and responsibilities for training and educating a rapidly expanding population of students for effective living in a complex democratic society. The educational requirements of a democratic society, as well as the needs for increased amounts and quality of knowledge, skills, and general culture, necessitate for the people expanding opportunities for study beyond the public school levels, in colleges, universities, professional schools and during adulthood. During the first quarter of the 20th century, a high school education was considered adequate by many people. Now, however, similar individuals expect and demand a college education or even graduate training. In almost every area of higher education there is expansion; the need to do more and better work. This general situation presents to colleges and universities a family of critical problems which combine to create what is termed a crisis in higher education in America.

1-2 Basic Problems in Higher Education

A sound perspective on the use of closed-circuit television in college and university instruction requires definitions of some of these major and basic problems of higher education. Subsequently, it is necessary to show how the potentials and limitations of this closed-circuit television equipment relate functionally and realistically to higher education and how it may be used to solve these problems.

1-2-1 Numbers of Students

Those conditions and factors which influence and determine student enrollments in colleges and universities weigh predominantly in the positive direction and are basic to estimates of greatly increased college populations. Population growth, economic conditions, prestige and actual merits of a college education, as well as the rising vocational and professional standards, operate to increase the numbers of high school graduates who go to college. The low cost of advanced training in relation to demonstrable dividends, in terms of earning power, its general availability, and the social status and prestige which result also increase the numbers who want to go to college. Negative factors such as availability of jobs and good pay, especially for technical employment, relatively high costs to the individual of a college education, chances of academic failure, etc., are outweighed by the positive incentives and determinants which increase college enrollments.

Careful studies by national organizations, by states and by individual institutions have led to conservative estimates that by 1965 to 1970 enrollments in the majority of colleges and universities will be increased by at least one third. For example, it is expected at the Pennsylvania State University that by 1970 the total number of students enrolled in the System will increase from about fourteen to twenty-one thousand. Estimates for the Michigan State University and the Ohio State University are that present enrollments may be doubled by 1970. Publicly supported institutions will receive the full impact of this enormous increase of demand for educational services. Perhaps to a somewhat less extent "privately" endowed and supported institutions will be forced to share in the increased public demands for higher education.

Alert administrators of colleges and universities, both "public" and "private," are planning and projecting plans for the unprecedented expansion and development of their institutions. They are anticipating the time when the ground swell of student populations now in primary and secondary schools will arrive in colleges and universities. Population trends analyses indicate that graphic representations of enrollment increases will not be in the form of a wave or cycle, but for a long period will have the form of a new plateau. Projection of trends indicates positive acceleration over a period extending well into and perhaps through the last quarter of this century.

1-2-2 Quality Considerations and Ideals

In terms of their ideals of higher education, educators would probably not by choice elect to have this great expansion occur at the university and college levels. Some view the current and impending trends toward "mass education" with foreboding and alarm. Proposals for avoiding the avalanche of students are given serious consideration. There are those who propose stabilizing student enrollments and making admissions and selections more limited and restrictive than at present. It is argued that too many unqualified men and women are now in colleges; many are not qualified to take due advantages of opportunities afforded them for higher education. It is proposed that more careful assessments be made of human resources, individual capabilities, and that only the qualified be selected to go to college. Protagonists of this view would seek all means of maintaining and preserving personalized instruction, close relations between faculty members and students and intensive student-teacher interactions for the selected elite individuals. Generally the argument is that everything possible should be done to maintain the *quality* of higher education, and it is implicitly assumed that if this is to be done, the traditional methods are the best to be used along with limited enrollments of students.

Institutions of higher education confront a clear and definable dilemma. It seems to be *inevitable* that the numbers of college students will greatly increase during the next decade. If this is accepted, then two critical problems confront higher education: 1. How can this increased number of students be accommodated? 2. How can the quality of education be maintained or prevented from deteriorating?

There seem to be widespread assumptions held by many or perhaps most educators that small enrollments, small classes, high faculty-to-student ratios and intensive personalized instruction are *absolute essentials* to high quality instruction. These factors are often arrayed as evidence of superior education. Conversely, large enrollments, large classes, low faculty-to-student ratios and extensive instruction are factors assumed to characterize education of low quality. Resolution of the acute and pervasive dilemma may be found in the solution to a single, difficult and challenging problem: What steps can be taken, what things can be done by colleges and universities which will make it possible to *accommodate satisfactorily greatly increased enrollments of students* while at the same time certainly maintaining standards and, if possible, *improving the quality* of education?

It is improbable that any single simple solution will be found to this difficult and complex problem. However, it is reasonable to assume that under conditions of sufficient justification a great many things can be done in the broad context of higher education to improve the *efficiency* and *effectiveness* of most educative processes, and that many improvements can be made after accepting the necessity of teaching larger numbers of students more thoroughly, more rapidly and to higher standards of proficiency.

In this report closed-circuit television will not be proposed as a panacea or a single solution to these difficult and complex problems. It will be proposed, however, that this instrumentation be investigated and evaluated. It will be assumed that instructional television has potentialities which may be of value as *one* means of solving some of the problems which are confronting colleges and universities.

1-2-3 Space and Facilities—Amount and Kind

Characteristically, educational institutions are already actively engaged in planning, financing and constructing new buildings to meet the expected increases in enrollment. Typically, too, the probabilities are high that the rate of increase in numbers of students will continue to exceed the rate of increase of available space and facilities. Self-amortizing dormitories and foods services will be built or provided earlier and at a more rapid rate than classroom and laboratory buildings which require different financing. Therefore, efforts to secure more and larger buildings will not necessarily be the complete solution to the pressures of student populations especially for *academic space.* There will be compelling reasons for increasing greatly the efficiency with which existing classroom and laboratory space is used. This may include, among other things, extending the daily and weekly usage of such space and otherwise making the most efficient use of classrooms and laboratories.

Available classrooms have not been built in many institutions for accommodating large classes. Hence, increasing the sizes of classes, were this desirable, is impossible because of the limited size of classrooms. The construction of classrooms for 20-50 students has resulted from the unproven assumption that generally small classes are better than large classes. The Pennsylvania State University has available very few large classrooms, auditoria and lecture halls. The problem is how to use most effectively large numbers of small and average sized rooms. This University may be typical of many others in this country.

It is almost alarming to observe extremely conservative and traditional academic buildings being constructed when radically new and different physical space might be needed in the near future to meet the requirements of new demands and new methods of teaching. The acute problem of getting adequately expanded physical facilities is linked with the more difficult problem of securing the *kinds* of buildings and equipment which will be appropriate to changed and improved educational methods and the new instructional requirements of the future.

The availability and adequacy of academic space and facilities are not now uniformly distributed over the various fields and curricula of colleges and universities. Nor will there be equal distribution in the future. The space and facilities for physical science and some technical fields are becoming increasingly overcrowded as they are used, and these fields which already have better than average facilities, relative to the social sciences, arts, education and the humanities, will probably have first priorities for new space. Two assumptions are here operative:

1. That, in terms of traditional methodology, the sciences and technical fields absolutely require extensive laboratory space and facilities, and

2. That for most other fields there is need only for a classroom equipped with fixed seats, a blackboard and chalk. Both assumptions need to be challenged and investigated.

Closed-circuit television cannot substitute for buildings and laboratories, wherever needed and justified, but this audio-video projection system should be objectively evaluated and taken into consideration in the planning of future physical facilities. It should be viewed as one means of supplementing and adapting buildings and facilities for meeting demands of the present and future. The educator who will do this may find solutions different from conventional ones for a number of critical problems of physical facilities in colleges and universities.

1-2-4 Adequate and Qualified Faculties

Educators and the public are becoming aware of current teacher shortages in primary and secondary schools of this country. Equivalent shortages of instructors or faculty members exist at present in some areas of colleges and universities; perhaps engineering and other applied science areas have critical shortages. Acute limitations in the availability of college teachers are expected to begin to be evident in most areas of college instruction during the period 1958-1960 and to become progressively more critical during the 1960-1970 period.

Traditionally, institutions of higher education do not prepare themselves for emergencies in advance of their occurrence. As with buildings and facilities so also with staff and faculties, the needs will be met, or steps will be taken to meet them, only after the needs and consequent demands make possible the necessary actions to solve the problems. Perhaps this must be so because of the order of events inherent in methods of administering and financing education in the United States. Unlike large industries or federal government operations, it is exceedingly difficult, if not impossible for educational institutions to justify to their constituencies the provision of buildings and facilities, or staffs and faculties, preparatory for use even in the near future.

Another factor which has a direct bearing on the problems connected with growth and expansion is the conservatism of college and university faculties; there is a slow rate of adjustment which lags behind social change, and a reluctance to accomplish advanced planning and the expeditious execution of such plans. Adherence and conformity to tradition prevents the taking of risks and responsibilities involved in spearheading adaptations to rapid social change. Accordingly, attempts to increase faculties in advance of their full use would probably be resisted.

It seems to be highly probable that colleges and universities will not be able to build up their faculties adequately to meet the expected increased enrollment of 1958-1960 and forward. If this delayed action occurs, expedient actions will be taken and improvisations will be made as they have been made in the past. This will take the form of employing larger numbers of teaching assistants, less well-qualified instructors, and many substitute teachers. Furthermore, with rare exceptions, classes will be entrusted solely to members of the diluted faculties without "on-the-job training" or what would seem to be necessary and desirable supervision.

Perhaps these are the darkest shadows of the future picture. There are by contrast some brighter areas of the scene. In the faculties of most colleges or university departments there will be some good or even superior teachers. There will still be those invaluable persons who are fully dedicated to teaching and to the education of students. There will be individuals who have successfully avoided the demands of secondary or even tertiary duties, including the numerous pseudo-administrative tasks which consume so much time and energy. These men will have kept in clear view the primary objective and principal justification for most educational institutions—to teach students well, both broadly and deeply and to the limits of their possibilities.

The superior and devoted teacher may then deserve and need to have his influence, his *instructional power*, greatly extended and vitalized to a degree which may not be possible with conventional means and methods of instruction. New approaches may be essential.

The superior teachers may find it necessary to a greater extent than ever before to teach younger and less experienced teachers to teach. Teacher training cannot then be relegated or the responsibility for it displaced to departments of education. New means may be needed for effectively using models of excellent teaching as a method of training instructors. The superior professor will need to have his teaching observed and critically analyzed by his junior colleagues. Many other methods of teacher training may need to be employed.

In this connection, closed-circuit television and large and well-equipped auditoria, of which there are usually too few in most institutions, are two possible ways of extending the influence and instructional power of good or superior teachers.

1-2-5 Increasing Scope and Differentiation of Curricula

There are other factors in addition to numbers of students which are operating to increase the demands made on colleges and universities: More students are being taught *more subjects*. Furthermore, *higher levels of mastery* are being required. The weaknesses of specialization and concentration in narrow fields are being revealed. Some areas like engineering and architecture are developing five-year programs of study. A few industries are returning their narrowly trained but promising young administrators to universities for concentrated study in liberal arts subjects.

A part of this complex problem of breadth, intensity and adequacy of education relates to the difficult processes of curricula-building and revisions. Characteristically, new courses are added to curricula, courses are differentiated, general courses are fragmented into specific courses, and remedial integrative courses are developed, once the processes of differentiation and fragmentation have run their course. New courses or even new curricula are added easily and rapidly. Old courses are discontinued slowly and with great difficulty. Costs and the full valid implications of those changes are rarely adequately considered with reference to defensible and sound educational objectives. These trends are not likely to be reversed easily.

Instructional television should be considered as one means of managing large integrative courses. Also, this system may make it possible to economize on faculty time in large courses and thus provide time for teaching necessary and justifiable specialized courses.

1-2-5-1 Increasing Emphasis on General Education. There is a growing interest in *general education* in the United States. Problems arise as to how fundamental courses can be taught to the majority of undergraduates. One university has assigned four faculty members to the task of preparing and teaching an interdepartmental course in International Understanding. After this course is fully developed, it is possible that about 1000 students per semester may take it. It is probably not practical to assign and train additional teams of instructors for additional sections —the faculty members have their special fields of interest, other than this course, which they are reluctant to surrender.

It is suggested that instructional television may be a means of making it feasible to staff and conduct such extensive integrative classes and interdepartmental courses.

1-2-5-2 Expanding Graduate Education. Graduate education is developing proportionately far more rapidly in many universities than undergraduate work. This fact is frequently not emphasized in reports and estimates of institutional growth. For example, whereas at the Pennsylvania State University undergraduate enrollment is expected to increase 30-50 per cent by 1970, it is conservatively estimated that during the same period the Graduate School will have a 100 per cent increase. This comparative growth rate will probably be reflected in many other comparable institutions.

The expansion of graduate education is already taking place and will have to be accelerated as the principal means of obtaining trained men and women for faculty positions.

These developments on the graduate level relate directly to the problems of undergraduate teaching, faculty work-loads and services. It is a reasonable estimate that about five times as much effort is required to supervise and direct a graduate student working for an advanced degree as to teach an undergraduate student. This work-load differential needs to be defined and taken into account in building faculties for departments which conduct graduate training.

The clear fact is that graduate training is very expensive, consuming of faculty time and demanding of the highest capability. Too often graduate education is carried as an *overload*. Also, administrators often consider a graduate program and graduate students as a means of teaching undergraduate classes cheaply. Therefore, a number of factors are operating to place faculty members under great stress to find time for their heavy and demanding assignments for the work of graduate instruction and research.

Closed-circuit television should be considered as one means of aiding teachers to accomplish their teaching responsibilities in large multiple sections of undergraduate courses as expeditiously as possible, without permitting reduction in quality, and at the same time providing for the time needed for graduate education and research. It is probably not desirable or practical to consider the employment of television for resident graduate courses or even for most junior and senior courses unless these have very large enrollments.

1-2-5-3 Increasing Demands in Technical and Professional Instruction. Acute shortages of adequately trained technical and professional personnel are beginning to occur in such areas as engineering, chemistry, and clinical psychology. The demands for technical and professional men and the competition for them from business, industries, government agencies, and institutions other than educational, are causing shortages and rapid turnover in some faculties. In these areas, also, costs of instruction are increasing rapidly and disproportionately to other areas of university education.

Furthermore, in many areas of technical and professional training there is great need for more "*realism*" and authenticity in instruction. Subjects like applied chemical engineering or clinical psychology lend themselves appropriately to bringing the outside world and subjects of study into the classrooms, laboratories, and clinics. This has not been done to an optimum extent although the best efforts have been made perhaps in medical education.

The opportunities are at hand for improving and facilitating technical and professional education by using films projected over closed-circuit television systems and for televising realistic materials as part of instruction. Furthermore, once again the time of valuable faculty members may be saved for use in specialized and advanced technical courses.

1-2-6 Increasing Costs of Education

This is a time (1955) in the United States of an expanding economy and increasing living standards. Likewise costs of education at all levels are mounting. Whether these costs are increasing at a rate which is not in line with general economic indices is not surely known. It is seemingly true that tuition charges to students have not been increased commensurately with the costs of operating educational institutions. Tuition probably cannot be thus increased. Increasing costs, nevertheless, constitute a real problem for those responsible for financing education.

The most promising approaches to the problems of keeping costs down to a reasonable level would seem to be:

1. Increasing the efficiency of usage of academic space and facilities, and

2. Improving the efficiency of the work of faculties.

Certainly these problems are difficult. Analyses of student-credit unit costs of instruction should be made and all concerned adequately informed of the realities of costs of instruction.

Closed-circuit television should be evaluated both as a means of increasing the effective usages of academic space, of academic manpower, and of stabilizing or even reducing costs of instruction. If savings are possible, then these should be invested in the improvement of academic work.

1-2-7 Brief Summary

Major and generally recognized problems confronting higher education in the United States have been stated. These problems are: Increasing student populations; the imperative need to maintain or improve the quality of instruction; the possible critical shortages of both the supply and the quality of instructors; the need to make more effective use—to extend the teaching powers—of good and superior teachers; the increasing scope, differentiation and fractionation of courses and the increasing costs of college education.

These are certainly not all of the complexes of problems which confront higher education. They are, however, some of the main ones relative to which instructional television offers possibilities of contributing to their partial solution.

1-3 SOME PROBLEMS OF IMPROVEMENT OF INSTRUCTION

The objective of improvement of the effectiveness of the instructing-learning processes should be a constant emphasis and objective of higher education. Teaching is such a difficult and complex task that few if any instructors ever reach the limits of the possibilities. So many factors are involved in teaching and being taught that it is exceedingly difficult to determine cause-and-effect relationships of these factors. Instruction is a complex interrelation of both science and art; in some respects the results resist objective analyses. Being highly personal both for the teacher and the student, the processes involved are difficult to objectify and validate. Nevertheless, there are definable requirements, characteristics, and criteria of good instruction. There are determining conditions which can be specified for effective teaching and for learning. Some of these may relate directly to the employment of instructional television as a means of meeting the impending crisis in higher education.

1-3-1 Teacher-Student Responsibilities

A principal axis of education is that of the relative responsibility for learning which is accepted and exercised by the teacher and by the student. The stereotype concept of this relationship is that the instructor has the information, knowledge and skills which he *transmits* to his students. The lecture system, the "teacher-dominated classroom," the gradients of authority and control, all devolve from this master-to-pupil concept.

In contrast, it is possible to conceive of the role of an instructor as including the following functions:

1. Creating interest and enthusiasm (motivation) in students for the learning of important information and skills.

2. The formation of new and the restructuring of existing attitudes favorable to scholarship.

3. Guiding and assisting students in the difficult tasks of becoming cultured and educated men and women.

4. Assisting students in becoming mature and creative persons.

5. Aiding them in making their adjustments to complex professional and social requirements, and in increasing their capacities for accepting responsibilities.

6. Aiding students in learning to make sound judgments, especially those which involve many factors.

7. Encouraging students in the development of abilities to make critical analyses of problems on the basis of dependable information.

There are other definitions of the function of the college teacher. Agreements can hardly be expected. However, the point being made relates to the question of what should be the accepted responsibilities of the teacher for the student's achievements. It is proposed that the major responsibility for learning should be given the student in the fullest possible measure as he gains in abilities to accept and manage these responsibilities. Therefore, the role of the teacher becomes auxiliary; it is one of assisting and serving as required, and only as this is necessary for the student's personal and intellectual development. Hence, the teacher should be principally concerned with creating challenges and opportunities for the student and for stimulating and encouraging him in the acceptance of full responsibility for his own learning. Instructional television can probably be used or misused relative to these objectives and ideals. Teaching by closed-circuit television may be favorable to the encouraging of more independent, self-reliant study, and less direct dependence on instructors.

1-3-2 Emphasis on Textbooks

The ubiquitous textbook in American education is a major problem which challenges study. The textbook has assumed a place of overriding importance in determining what courses are given, in shaping college courses and determining their content. Many courses consist principally of drill and recitation on the themes and content of textbooks. It is a principal source of information often both for the teacher's lectures and for the student's readings. Furthermore, it is made the basis of examinations.

Accentuating this emphasis on textbooks is the extreme difficulty of making available appropriate source books and other library learning materials to large numbers of students in multiple-section courses. Likewise, especially in the arts, social sciences and humanities, laboratory work, demonstrations and problem-solving situations are difficult if not impossible to arrange for students within the established physical plant and procedures of many institutions.

Thoughtful faculty members recognize and deplore the limitations of *textbook-bound* instruction. However, there does not seem to be a better and practical alternative to these limitations, considering the advantages and conveniences of the textbook-lecture-reading system for teaching large numbers of students with the work-loads which most faculty members must carry.

It would seem reasonable to explore instructional television as one feasible means of bringing supplementary materials into courses. It may be used to make practical the use of a wide variety of methods which cannot usually be employed with large classes.

1-3-3 Emphasis on Lectures—Verbalism

Lectures are and will in all probability continue to be a main method of instruction in American colleges and universities. A constructive approach would be to attempt to improve the effectiveness of lectures for stimulating learning and to supplement the lecture method by other procedures in order to make the combination more effective than the lecture alone. The lecture-demonstration, the illustrated lecture and discussion group patterns are attempts of this kind.

Most experienced teachers have observed the limited amount of information which is actually learned and retained by students even from a "good" lecture. Evidence and impressions would suggest that "straight lecturing" is not among the most effective methods of instruction. Why is this apparently the case? It is suggested that the ineffectiveness of straight lecturing relates to several variables; among these are:

1. The factor of abstractness which too greatly exceeds the abilities of students to comprehend concepts presented on high levels of abstraction.

2. The amount of information presented and the *rate* of delivery ("rate of development").

3. Less than optimum repetition, reiteration and review.

4. Weaknesses in organization of the information.

5. Defensive accommodations on the part of students who are overexposed to lectures.

6. The failure of most lecture methods to get students personally involved in the information to be learned.

7. The division of attention involved in note-taking from lectures.

8. The systems which substitute the symbols of academic achievement, i.e., grades and credits, for the actual goals of education.

Instructional television may be used to focus attention on the needs for correcting and improving teaching methods. It may provide a means of presenting feasible demonstrations or illustrative materials.

1-3-4 Need for Realism in Instruction

Academic work in colleges and universities often becomes disassociated from the *living context* of students. It is a persisting problem of college instruction to make subject matter seem real and meaningful from the viewpoint of students, and relate information to their pliable and changing interests or to their variable personal and professional objectives. Yet to ignore this difficulty and not attempt to solve it may result in the loss of effective intellectual contact with students.

One need in this connection is for a means of bringing true-to-life situations into the classroom for study, analysis and discussion. This need exists whether the study is electronics, languages, psychology or history. The question is, how can this be done in a feasible manner? Closed-circuit television is one method which can be used after suitable materials have been prepared. These can be presented directly as with demonstrations, or presented from graphic and photographic media.

1-3-5 Pictorial-Graphic Communications

Many of the attempts to introduce realism and lifelikeness into academic work have taken the form of laboratory exercises, field practice and the workshop courses. These procedures have advantages but they also have limitations. With the development of the graphic and photographic arts in communication, ways are at hand for representing to students a vast array of complex information in these forms. The printed page and the spoken word can be importantly reinforced and made explicit and concrete. Also, many objects or situations can be accurately and fully represented by graphic and photographic materials as an effective alternative to teaching with actual equipment or even in field situations. Furthermore, this can be done, it is believed, more feasibly, at less cost, and without loss of instructional effectiveness. We have only begun to explore in university instruction the field of pictorial materials for teaching and to determine their relevant potentialities and limitations.

Closed-circuit television may prove to be one of the most effective projection systems both for photographic and recorded instructional materials.

1-3-6 Difficulties Involved in Studying and Improving University Instruction

It is an extraordinary fact that college and university instruction is so refractory to objective study, a necessary antecedent to improvement. The professor who will invite his colleagues to analyze critically his research and will accept and appreciate suggestions and criticism, takes a different attitude about his instruction. The privacy of the classroom is held to be sacred. The concept of "academic freedom" is misinterpreted, and used as a blanket of defense spread over all matters of instruction including both content and methods. Furthermore, problems of extreme complexity which would usually be referred to research for answers in a substantive field like physics or biology are argued on the basis of opinion when they deal with problems of teaching and learning. Critical, objective and systematic analyses are not made of instructional processes.

Clearly this must be changed. If teachers are to work effectively, if methods of instruction are to be improved, if academic standards are to be maintained or raised, then objective, analytic, systematic and quantitative studies must be made of the *teaching processes* as these relate to the achievement of students. Instruction must be taken out of the private and brought into the professional domain where it can be investigated with the keen, cold objectivity which is an essential core of the scientific attitude.

Instructional television is an instrument which provides observational windows for the classroom and makes it possible to investigate teaching procedures, and this can be done without disturbing the normal processes of teaching and learning.

1-3-7 A Miniature Theory of Communication Applied to Instruction

It seems to be necessary as a means of improving the general perspective on what television is and is not, to review briefly some of the concepts of tele-communications, especially as these relate to tele-education.

Progress has been made in recent years in developing theoretical concepts of the process of communication. The terms "bits of information," "encoding," "decoding," "channels," "transmission," "information storage," "selectivity," "control," and "feed-back," among others, are becoming familiar to a widening circle of specialists in the fields of "systems research." These concepts are based on electronic models formulated by Wiener and Shannon in their books *Cybernetics* and *A Mathematical Theory of Communication.*

These concepts seem to have, with modifications, considerable implications for those concerned with understanding the processes of instruction and tele-education. As far as is known, the systematic consideration of transferability of these concepts to teaching-and-learning remains to be done. The following concepts have been important for an expanding field of communications theory and experimentation:

1. Communication consists of an exchange between a "sender" of information or "source" and a "receiver."
2. Information is "encoded" by the "sender" by using symbols, signs and signals to represent information.
3. These symbols, signs or signals are conveyed over some medium or channels to the "receiver."
4. The receiver "decodes" or translates the "vehicles" of conveyance and completes the information-reception process.
5. However, communication usually involves control and exchange of information; therefore, the receiver may reverse the process just described and transmit "feed-back" to the sender.
6. Thus, the communication cycle is completed.

This conceptual model has several serious limitations when applied grossly to human language and communication and hence to tele-instruction:

First, the symbols, signs and signals used to represent information originally may not in fact be entirely adequate or accurately representative of the original information.

Second, these "vehicles" are repeatedly translated and hence changed by those who are a part of the communications "network."

Third, the symbols, signs and signals are transmitted but the information *per se* is not transmitted; it is instigated, stimulated or aroused in the brains of the communicants.

Fourth, the receiver of the stimuli responds by changing and adding his own variations of the information to such an extent that the process may be indicated as a *releasor mechanism* rather than a process of transmission.

Fifth, interaction of new with relevant old information in the brain of the receiver may result in the reorganization of concept patterns.

Sixth, at every stage or phase of the human communication cycles, *selectivity* operates to modify the information or its meaning. There are many filters in the channels.

Seventh, "feed-back" and "storage" (memory) occur in the receiver, especially in his brain, and there need not always be a complete overt cycle back to the sender.

These concepts are helpful in thinking about the processes of instruction involving television. Essentially, television is neither "sender" nor "receiver"; it is a broad channel through which audio and video kinds of information, symbols or representations can be projected simultaneously over variable distances. A perspective on the place of television will be outlined later in this report.

1-3-8 Summary

In this section attention has been directed to some of the major problems of improvement of instructional methods and the relevance of the use of closed-circuit television to these problems. The problems which were selected were the following: teacher-student responsibilities, emphasis on textbooks, emphasis on lectures or verbalism, the need for realism and accuracy of representation in teaching, and possibilities of pictorial graphic communications. Comments were made on the difficulties of improving instruction.

In order to gain a perspective on television applied in education, a brief outline was given of some basic concepts in the communications field. Some limitations and extensions of these concepts were outlined.

1-4 EMERGENCE OF EDUCATIONAL TELEVISION

Technical developments stimulated partly by the recent war-research in electronics made television a reality, and provided a new "mass medium" of communication in the late 1940's and early 50's. Educational television is merely television applied to instruct, inform, train and educate. There is not a clear distinction between "educational" and "commercial" television. The main differences are in methods of use and the purposes which are served.

The organized movement for using television for educational purposes is well known and need not be reviewed here. Few developments in the field of education have been so consistently and forcefully promoted or so thoroughly documented as has educational television since 1950.

The main objective of the educational television movement is to encourage cooperative efforts to organize, finance, establish and operate *standard type television broadcast stations for educational purposes.*

Due perhaps to the costs, both of establishing and operating standard "commercial" type stations, progress has been slow, but steady gains have been made.

The nation-wide movement of educational television has called attention to but not emphasized closed-circuit television applied to instructional problems within institutions. Broadcasting of courses for credit has received some emphasis. Except in medical schools, only recently have closed-circuit systems been seriously and systematically thought of as a means of solving some of the acute problems of instruction in colleges and universities.

1-5 CLOSED-CIRCUIT OR INSTRUCTIONAL TELEVISION RELATIVE TO THE CRISIS IN HIGHER EDUCATION

In prior sections of this report, attention has been called to a number of problems confronting colleges and universities and the needs for the improvement of teaching. At no point has it been suggested that television *in any form* is the complete solution to these problems. It seemed possible last year (1954), and the possibilities are now increased, that closed-circuit or instructional television may be appropriately employed as *one* means of partially solving problems of the anticipated large increases of student enrollment and shortages of faculty compentencies by making it possible for available instructional manpower to present courses to large numbers of students. Television, therefore, has potentialities for compensating for expected shortages of faculties in colleges and universities. Television also has limitations which need equally careful evaluation.

1-5-1 Characteristics of Television

Television provides the means of transmitting both visual and auditory signals from a "source" to students. It has the potential capability of transmitting information and "influence" from a source to an *extended* audience or class of almost infinite size. Television, therefore, may make it possible for a single or limited number of instructors to guide, stimulate and direct the learning of very large numbers of students. With adaptations, it may be possible to capitalize on these well known potentialities and compensate for limitations of this "mass medium" and to do this in such a manner as to "enrich" and improve instruction.

Television is generally regarded as complex and expensive. These characteristics raise the basic practical problems of original costs, maintenance and operations or the problems of the economic feasibility of television.

Primarily, however, data are needed on what *effects* television has on instruction when used regularly over full academic periods.

1-5-2 Television Is Not a Method of Instruction

Information, stimulation, inspiration and other functions of instruction can be transmitted and projected by television. However, television itself should be clearly differentiated from these functions. Likewise, a wide range of methods of instruction can be presented to students *by means* of television but not *by* television. For example, lectures, lecture-demonstrations, panels,symposia, experiments, sound motion pictures or other graphics in still or motion form, and a wide range of other content can be variously presented. However, television *per se* is not these things.

Perhaps the conception that television is a dynamic "*tabula rasa*," or blank channel, until the information in a great variety of forms is provided, is approximately a correct representation of what television is and is not.

1-5-3 Relation of Television to Content

The content that is appropriately presented to the television cameras is, under conditions of good operations of the system, presented on the television screens for students to observe—more specifically to *see* and *hear*. Television does not supply content. It does not determine, to any great extent, the essential form of the instruction. Primarily these are determined by the instructors. With or without television the responsibilities for teaching and learning rest squarely with teachers and students.

1-5-4 Limitations and Advantages of Television Applied to Instruction

Transmission systems regularly have both potentialities and limitations. Early radios and recording equipment greatly attenuated speech and musical sounds. Telephotos greatly modify pictures. Black and white photography may not reproduce all texture, color is omitted and, except in stereoscopic form, the third dimension of depth may not be accurately represented. However, even with these distortions, the *meanings* which are the intent of the communications are perceived over a wide range of quality standards.

Likewise television has limitations. One of these relates to the dimensions of space which can be covered by cameras. For example, a full blackboard of written material larger than five feet in length cannot be televised entirely and yet be easily read from the receivers. Fast movements may be blurred. Objects must be well lighted to be clear. These physical limitations and others will be described in the technical part of this report.

The theoretical expectancy of television might well be that some limitations or attenuations may be imposed on instruction channeled through a television system to students. With this assumed expectancy three vital questions arise:

1. Do these limitations seriously distort the *meaning* or *significance* and "stimulus value" of the instruction for students?
2. Are there inherent potentialities or advantages which compensate equally or more for these limitations?
3. Are there other ways for overcoming or compensating for the limitations?

Television as a transmission or projection system has advantages. One good instructor can teach a very large number of students who need not be in one place but dispersed in space; they may even be off the university campus. Experiments, equipment and situations which cannot normally be shown students can be televised to them. By television undergraduate students can visit and observe clinics, experiments, shops, and situations from which they are usually excluded. Large classes may be given advantages now reserved to small laboratory sections.

Small objects can be enlarged. The outside world or events of the past can be brought into the classroom by using films to supplement television.

Instructional television has some advantages strictly from the viewpoint of the instructor. His voice is amplified. He is presented intimately in "close-ups" to students. He is given a new challenge and an increased sense of responsibility. Television may make possible wider recognition than would otherwise be the case. When courses are properly operated and serviced, the television instructor may have much more assistance than he has had in the past. He should find it possible to do his heavy teaching jobs in less time and hence have more time for advanced courses, research or creative scholarship. Finally, when the economics of televised instruction are worked out, the teachers who are most competent should share in these economic advantages.

1-6 NEED FOR OBJECTIVE-SYSTEMATIC RESEARCH

There are three broad classes of research which are urgently needed in the area of instructional television:

First, there is the area of basic or fundamental research on a wide range of problems such as the following: the effects of *psychological* goal-distance or perceived usefulness on learning, the effects of controlled overt and covert practice or responses on learning, the effects of the interactions between students and teacher on learning, and the effects of pictorial-graphic representation of information supplementing verbal instruction. Many problems in the areas of the psychology of motivation, learning, and perception fall in the category of basic research which needs to be done.

Second, there is the area of applied or developmental research. Here such problems as the following should be investigated: the full range of questions related to how instructional television equipment should be installed and operated, the problem of acceptance of television instruction by students and instructors, the problems of determining the degrees of appropriateness of television for different subject matter areas and levels of the university curricula, the problems of how to adapt successfully courses for television presentation, determination of relative effectiveness of different course patterns and the management of courses when taught by closed-circuit television, and the full range of problems having to do with costs and feasibility of instructional television.

Third, there is the area of technical engineering research. Equipment and systems development are very recent. It cannot be assumed that the best or most satisfactory equipment has been perfected. Many problems in the area of equipment development and engineering design become defined only in an experimental "proving ground" situation where the equipment is being put through the realistic sustained operations required in teaching university courses.

The stakes are too high for instructional television for those responsible to arrive at crucial decisions on the basis of best guesses or *a priori* reasoning. Continuing research carried out by the best possible methods should be planned and done as an integral and continuing part of the development and application of television to problems of instruction in higher education.

1-7 SUMMARY

This section has dealt briefly with the emergence of educational television. An attempt has been made to sketch the general characteristics of closed-circuit television. It was emphasized that television *per se* is not a method of instruction nor is it course content. With television the teacher, his subject and students are the main considerations. Television has limitations and advantages. The problem becomes, therefore, how to use its potentials and overcome or compensate for the limitations.

2—The Penn State Instructional Television Project

2-1 Origin of Concepts of Project

There were four lines of developments and interests which led to plans for the Penn State Instructional Television Project:

1. Research and graduate training of the Instructional Film Research Program.

2. Awareness of and interest in the need to apply available information to the improvement of instruction on the level of higher education and to solve many related practical problems.

3. Interest of the University in educational television on the local, state and national levels.

4. The interest of the Fund for the Advancement of Education in attacking, in advance of a critical time, the problem of shortages of teachers, and more specifically of discovering ways and means of extending the influence of good and superior instructors to larger numbers of students than is possible with conventional methods, facilities and buildings.

The Instructional Film Research Program had been engaged for seven years, by 1954, in an extensive research effort to formulate and discover facts and principles which when applied in instructional sound motion pictures would increase their effectiveness for training large numbers of men rapidly and to high levels of proficiency.

It was decided for many reasons to reorganize this research program and to formulate new objectives. As part of the reorientation of the Instructional Film Research Program it was decided to try to bring the research results and other related information to bear on problems of rapid and effective instruction of large numbers of students and to focus these research findings on selected courses at the University.

The similarities which exist between instructional sound motion pictures and instructional television suggested that some kind of integrated work with both media might be possible and would be desirable. It was also believed that something could and should be done to initiate active research in the area of educational television. It was observed that in spite of the widespread interest and activities in the field of educational television, the emphasis on research was being almost completely neglected except in the military services. Furthermore, it was hoped that some means could be found for resolving the conflict at this State University between strong active interest in educational television and the inability to find practical means of financing, organizing and operating a television broadcasting facility. At least we hoped to secure the minimum necessary means for conducting research and local training of faculty and students in instructional television.

It is a curious phenomenon of higher education that although the subject of the ***improvement of the efficiency of instruction*** is of fundamental importance and is widely discussed, there is extremely limited organized and concentrated research directed toward the objectives of increasing the efficiency and quality of instruction. It seemed possible that this would be a challenging area for the reorganized Instructional Film Research Program. Many factors at Penn State indicated that this Institution would be a most favorable place in which to undertake research and development work on the improvement of instruction in college and university courses. Among these were the strong interests of administrators, the experience gained from film research, and most important, a latent readiness of the faculty for undertaking such studies.

The Fund for the Advancement of Education was approached and it expressed, at first, general but critical interest in plans. After a series of conferences it was suggested that a proposal be submitted to the Fund.

Thus, the four lines of development and interest began to be brought together, formulated and integrated toward defined objectives.

2-2 Development of Specific Concepts of the Project

General objectives and approaches were at first formulated. The following preliminary objectives were specified:

1. To bring all available and relevant information together and apply this information toward the goal of improving ***to a maximum*** the efficiency and quality of instruction in a small number of selected courses.

2. To define the problems and barriers which operate to impede efforts to improve instruction and to find ways of solving these problems and overcoming these barriers.

Generally, the approaches were defined to include:

1. Selecting courses which exemplify needs and critical problems and for which there existed interest on the part of instructors and reasonable possibilities for accepting the demands which would be made by the proposed work.

2. Assembling information relevant to the problem of improving instruction and translating this into applied form, practical materials and procedures.

3. Using a combination of methods and instructional materials with emphasis on making maximum use of sound motion pictures, graphics, and photographs channeled through closed-circuit television.

4. Employing the best possible research methods and quantitative measurements within the limitations of practical requirements in order to evaluate the effectiveness of the methods of instruction.

2-3 The First Proposal to The Fund for the Advancement of Education

Against the background of the orientation described above, a three phase program was outlined for the Fund for the Advancement of Education:

1. To design the best possible patterns of instructional methods, consistent with known principles of teaching and learning at the university and college level, and to use these methods to teach selected and organized parts of a chemistry and a psychology course.

2. To explore the full possibilities of presenting the developed courses principally through closed-circuit television to classes, using also, where appropriate, sound motion pictures, graphic and pictorial materials and sound recordings.

3. To test the feasibility of the *extended* and intensive application of the "mass media" to college and university instruction as a means of improving the quality of instruction and enlarging the sizes of groups of students effectively handled by one or a few instructors. Finally, it was planned to make kinescopic or film recordings of the developed and modified courses. In brief, the proposal was to replan and further develop parts of selected courses, produce and test the materials which would be presented through closed-circuit television, to teach the modified courses and compare them with conventional methods used in these courses and to record them on film.

It was estimated that this project would require a staff of ten or twelve people, in addition to the instructors, working for a two-year period, and would cost over one hundred thousand dollars.

2-4 Counter Proposal by The Fund for the Advancement of Education

Officers of the Fund reacted to this proposal by stating the following points either explicitly or by implication:

1. The Fund's principal concern was with the impending shortages of teachers.

2. Closed-circuit television seemed to have possibilities for making it feasible for a few good instructors to reach and influence large numbers of students.

3. Developments in which television is used must be *feasible* for educational institutions in terms of original costs, operating expense and manpower. Furthermore, the developments must be acceptable to the personnel of colleges and universities.

4. The Fund was not able to support at that time complicated research on the effectiveness of methods nor research on the problem of *maximum* improvement of instruction in limited courses. What was wanted was a realistic demonstration using selected courses *taught as usual* for an *entire semester* over closed-circuit television.

Therefore the burden of proof and the development of a justifiable proposal in these general terms reverted to those at Penn State who were interested in the project. Clearly, a very different conception from the original proposal had to be developed.

2-5 Reassessments and Feasibility Considerations

It became necessary to restate the problems and also to define clearly the limitations within which the work might be done. The idea of using standard commercial image orthicon television equipment appeared to be impractical on two counts: First, original costs, even with possible educational discounts on used equipment, would exceed upper limits of estimates of funds available for the project. These costs are probably also excessive for most colleges and universities which might use the equipment in the future. Second, it was judged that the types of television equipment needed should be dependable, relatively trouble-free and simple enough to be operated and maintained by the engineering skills available in educational institutions. This would make it possible to avoid the expense of employing full-time television engineers, a requirement not easily met even in large universities at this time of shortages of engineers.

As the thinking about the employment of closed-circuit television to teach large, multiple-section and appropriate courses over the full range of a university's curricula offerings was surveyed, another problem not previously considered was defined.

Most thinking about educational television had been structured around *one* television center or station located at or near a university. A modification demonstrated by the military services consisted of mobile caravans elaborately equipped with image orthicon systems. Also, standard commercial type closed-circuit systems were known to be in use in several military installations. None of these patterns seemed to fit the needs and fall within the limitations existing in colleges and universities.

2-5-1 Low Cost and Multiple Systems

Theoretical study of eventual needs showed that one station, one center or even a mobile caravan would not be appropriate and adequate for course instruction in a university. The possibility was seen that a large university might need ten or more systems. This estimate was based on the presupposition that instruction via closed-circuit television could be shown to be acceptable and practical, and that the procedure would not deteriorate the quality of instruction.

The conception that a university may need to use television systems regularly for courses in chemistry, physics, education, psychology, liberal arts, fine arts, drama, speech sciences, social sciences, engineering, agriculture, etc., further emphasized the absolute necessity for the selection of systems which, among other things, had to be of relatively low initial cost. Few educational institutions have found it possible to finance even one television center. The hypothetical requirement of multiple systems distributed over the institution and operated *simultaneously* as required by class schedules would certainly be impractical with the high cost commercial image orthicon systems.

Consideration was given to the possibility of installing image orthicon systems which were largely portable as far as the cameras and other expensive units were concerned. Although this plan seemed possible at the time it was considered as an awkward and probably unsatisfactory arrangement, and impractical if courses had to be handled simultaneously in different buildings.

Information was received at about this time on vidicon type television equipment which relative to image orthicon equipment was:

1. Very much lower in cost.
2. Compactly "packaged" and hence semi-portable.
3. Believed to be relatively simple, reliable and easy to maintain.
4. Capable of producing pictures and sound of adequate quality.

It was also learned that there were two types or levels of vidicon equipment: the "Professional" and "Industrial" types. On the basis of limited comparative data it was decided to use in the proposal one "Professional" system and one "Industrial" system in preparing the prospectus, and it was hoped that operational comparisons could be made on them when used for instruction. A further discussion of this equipment and its selection appears in Section 5 of this report.

2-5-2 Relation of Instructors and Operating Staff

The methods of staffing the operation of a television system were of concern. A long history of events and research projects of the Instructional Film Research Program, especially work on methods of producing low cost but adequate films with a minimum staff, led to the conclusion that some specialized jobs usually thought necessary could be eliminated both in film production and in the operation of television equipment. Experience with film production showed, furthermore, that instructors and technical advisors usually lost much of their control in their areas of competency to the film producers, writers, directors and camera crews. This loss of control seemed to be a source of great frustration to individuals more interested in teaching than in the techniques of film production. It was reasoned that the same conditions prevailed when television was applied to education.

Therefore, it was decided that a minimum number of people, and students wherever possible, would be used to operate the experimental systems. Those people would be at the service of the principal instructors of the courses. The formulation was: *The autonomy of the instructor shall not be infringed. He shall have complete control and responsibility for conducting the course.* This key concept led to many changes in conventional television procedures, and determined the plans for those who would work on the proposed project as instructors. (See Section 6 on Operation of the Television Systems.)

All of these considerations had a direct bearing on the kind and scope of the project which was proposed to the Fund. Obviously considerable risks were being taken and the probabilities of success were estimated to be sixty for and forty against success.

2-6 STATEMENT OF THE ACCEPTED PROBLEMS AND OBJECTIVES

The general agreement with the Fund for the Advancement of Education was that a research project would be conducted during the period August 1, 1954 to August 31, 1955 by part of the staff of the Instructional Film Research Program in cooperation with the Departments of Chemistry and Psychology.

The principal purpose of this project was to study the effectiveness of unmodified or conventional courses when taught for a full semester over closed-circuit television using "moderate" cost equipment, as compared with the same instruction given in the usual manner. It was agreed, furthermore, that information would be collected on the acceptability of televised instruction to administrative officers, the faculty members and to students. Finally, it was planned to study the problems of the feasibility of instructional television as far as this would be possible within the rather limited scope of the project as planned.

In addition to these main objectives there were several secondary ones. It was believed to be almost inevitable that sometime in the future the University would necessarily become involved in educational television broadcasts. Hence, the use of closed-circuit systems in a realistic way would provide training opportunities and familiarization for both faculty members and students. It was believed that the introduction of instructional television would focus attention on problems of improving instruction, provide a means of introducing more realism and concreteness into courses, and would emphasize the needs and possibilities of methods research applied to college and university courses.

Generally it was hoped that, if the project proved to be successful, Penn State could apply the results and assist other colleges and universities to develop practical ways of using instructional television in their educational work, especially as a means of teaching larger numbers of students with limited faculties.

2-7 SELECTION OF COURSES FOR THE PROJECT

General Chemistry was selected as a representative physical science course of basic importance which is required in a large number of curricula, and hence in most institutions has a large enrollment. Instruction in General Chemistry is given in three parts: (1) lecture demonstration, (2) recitation, and (3) laboratory work. It was decided that only the lecture demonstrations (two hours per week) would be televised in the study. The lecture demonstration part of the course was judged to be less difficult to televise than General Biology, for example, but more difficult than General Physics. The fact that color and color changes are shown extensively in chemistry demonstrations caused much concern about the adequacy of black and white television for presenting the demonstrations. Selection of General Chemistry importantly related to the strong interest in that department for improving instruction and efforts were already being made toward this end. Finally, the faculty members of Freshman

Chemistry and the department head were willing to take risks, to invest the additional effort which would be necessary and to undertake experimentation on instructional methods.

General Psychology as taught at Penn State, and at most other colleges and universities, is a lecture discussion course required by many curricula and elected by a considerable number of college students. The course at this University is usually taught by faculty members of all ranks, and by graduate student assistants, in sections of from 35 to 60 students. The number of sections per semester ranges from about 14 to 20. Since classes are often scheduled in different rooms and buildings it is difficult and often frustrating to attempt to use demonstrations and suitable graphic or photographic materials including motion pictures. Efforts have been made for many years to strengthen the course and achieve what are believed to be the potentially important contributions of such a psychology course for a very large number or indeed for all college students.

General Psychology seemed to be rather typical of courses taught principally by the lecture discussion method and therefore more representative of liberal arts than science instruction. Furthermore, it was a course which seemed to have unusual possibilities for development. It was believed that perhaps eventually by using instructional television to the best advantage, the same results could be achieved as would be the case were it possible to teach the course as a laboratory science. This was especially worthy of exploration since it is highly improbable that this latter will be done in American universities because of the lack of adequate buildings and facilities for departments of psychology. In any event, General Psychology seemed to be a suitable course with which to experiment.

Originally it was planned to work only with courses in General Chemistry and General Psychology. However, after registration it was found that a course in the Psychology of Marriage had a heavy enrollment. The professor in charge requested that the class of 130 be divided and that sections be assigned to another teacher. An additional instructor for this special and rather difficult-to-teach subject was not available. By chance, the course had been scheduled in the same room and at a time immediately following a group of sections of General Psychology using a television system. Here was a real problem of the kind that may become frequent in higher education as enrollments increase in college education. It was proposed that television be used as a means of solving the problem. The professor was somewhat hesitant at first but later agreed to the suggestion. In this unplanned way a third lecture type course which has a very personal and somewhat clinical content was added to the project.

2-8 PRE-EXPERIMENT AUDITING OF COURSES

The General Chemistry lecture demonstrations and the lecture discussions of General Psychology were audited during the fall semester preparatory for televising them during the spring semester. Auditing was done by the individuals who would be responsible for televising the courses. Also, it was hoped that those assigned to the task of developing measurements would also audit the courses systematically as one means of developing adequate measures of student achievement. This latter occurred to only a limited extent.

Principally the courses were observed, particularly General Chemistry, to learn of the special problems which might arise when the lecture demonstrations were projected over television. Information was also collected on problems related to the installation of equipment, including lights, so that its operation would cause the least possible interference either for students or for instructors.

2-9 SUMMARY

This section sketched the background which led to the proposal of instructional television research at Penn State and its submission to the Fund for the Advancement of Education. The original proposal, the Fund's position, and the several revisions were outlined. It should be clear from this section that limitations imposed on plans by realistic thinking about practical problems led to several rather novel approaches to the use of instructional television in colleges and universities. Furthermore, in this section a statement was given of accepted problems and objectives of the project. The reasons were given for selecting the courses in Chemistry and Psychology for the study.

3—Organization of the Project

3-1 Background

The organization of the Instructional Television Project grew out of and was in many respects simply another one of the many research studies done by the Instructional Film Research Program. The existence of this active program and experienced personnel along with necessary office space and other resources greatly facilitated the work. Thus, much time was saved and many difficulties avoided. Furthermore, the Instructional Film Research Program had been accepted by the faculty and had a reasonable amount of respect from those who would take part in the television project. Certainly favorable attitudes outweighed unfavorable ones.

Those individuals who planned and helped initiate the project were careful to secure the participation, involvement and approval of all levels of the University's administration. All the administrative officers affected by the project signed the proposal. A considerable amount of preliminary explanation and exploratory work was done with the Freshman Chemistry faculty. It was assumed that the project would be enthusiastically accepted by members of the Psychology Department, and for this reason, and due to the pressure of time, preliminary discussions and planning with faculty members in that department were not done thoroughly and systematically.

3-2 Work Groups

The main groups to which special responsibilities had to be assigned were the following:

1. A small group designated as a Steering Committee, made up of an assistant to the President, the Provost as an *ex officio* member, and heads of the Departments of Chemistry and Psychology, maintained general perspective on the project, kept itself informed and stood by to make crucial policy decisions or resolve conflicts which might develop.

2. A committee of five competent individuals was designated to work on the tasks of experimental design, tests and measurements. After the project was set up, however, most of the work in this area was done by two staff members of the Instructional Film Research Program working with the principal instructors in the courses.

3. The problems of selecting, purchasing, installing and operating the equipment were worked on by all who could contribute to their solutions. Principal responsibilities were accepted by staff members of the Instructional Film Research Program, especially the Associate Director, the Cameraman and the Writer-Director. Much help was required from the Departments of Physical Plant and Purchasing in order to get work done on schedule.

4. The three instructors mainly responsible for teaching General Chemistry worked closely together as a team. The two instructors in General Psychology coordinated their work to a limited extent but mainly taught their courses independently. The instructor in the Psychology of Marriage worked independently. All instructors were given help as and when requested but they also retained complete authority and responsibility for their courses.

General meetings of all instructors, and others working on the project, were called several times for informative and orientational purposes. In general, however, instructors had complete freedom, and were not organized. The roles of all individuals on the project were defined in terms of service in the interest of instruction and the conduct of the project.

3-3 Operators and Teaching Assistants

The equipment was operated by members of the Instructional Film Research Program staff assisted by students and three other faculty members, one from Education, one from Speech and one from the Audio-Visual Library.

It was considered desirable to have a "teaching assistant" in each section or receiving room where instruction was given over television. In chemistry regular faculty members were assigned in television classrooms. One regular faculty member, two staff members of the Instructional Film Research Program, and three graduate assistants were assigned to Psychology courses. Sub-groups of these individuals met occasionally as the need arose.

In all instances the teaching assistants took a minor or no part in instruction. Their principal responsibilities were to observe instruction and the reactions of students, to detect problems and report them, to make suggestions and to assist with the mechanics of receivers and tests.

3-4 Characteristics of the Informal Organization

The Instructional Television Project was organized with a minimum of formality. This was made possible by the fact that, with minor exceptions, individuals working on the project accepted their responsibilities and discharged them in a satisfactory manner.

3-5 Role of the University Administration

Complete cooperation and support were given the project by the President, Provost and Comptroller. Furthermore, other officers of the University including the Scheduling Officer, Director of the Physical Plant, Director of Purchasing, the Deans of Colleges and Department Heads gave their full support. The Administrative Council and Procedures Committee were kept informed of problems and progress. Unequivocal administrative support is absolutely essential to the conduct of projects like the one being reported, which impose so many new adjustments on faculty and staff members.

3-6 SUMMARY

The project was planned and organized in a very informal manner. Administrative officers and groups at all levels accepted the risks and responsibilities. Instructors retained full autonomy and taught their courses without modifying them. No "professional" television specialists were employed. Considerable use was made of student assistants.

4—Methods and Procedures

4-1 Course Plans

Several general experimental designs for the experiment were considered. One was selected which best compared learning in the television sections with learning in a conventionally taught class. This design required that the instruction be given simultaneously to the conventionally taught class and televised to the receiving sections. The room in which the telecasts originated is hereafter designated O-R, originating room. The rooms in which the telecasts were received will be designated receiving rooms.

Within this general design framework, however, it was thought desirable to add another condition. A control group was planned for which instruction would be given in the conventional way *without* the lights, cameras and other equipment of television being present. It was thought possible that the presence of the television equipment, lights and operators might distract the students or provide unusual interest; it might inhibit the instructors or act as an additional stimulus for better preparation and presentation. Hence, this control group was necessary.

For the comparisons to be meaningful it was of course necessary to control or keep constant all of the variables which might influence the students' learning, the most important of which are instructors and the instruction itself, and the initial abilities and interests of the students in the several groups.

The fundamental organization of each of the courses was *not* to be changed[1] and, therefore, since their organization to begin with could be assumed to differ, the implementation of the basic design varied from course to course. Consequently the details of the general experimental design must be described in relation to each of the three courses.

4-1-1 General Chemistry

The chemistry course selected for the closed-circuit television study is designated as Chemistry 2 in the University catalog. This course is the second semester part of one of the two principal introductory courses offered by the Department of Chemistry. It is a five-credit course which consists of two lectures, one recitation and two laboratory periods of three hours each per week. Factors influencing the selection of this course for the study included: the large number of students involved (about 450), the uniformity of laboratory conditions and location, the previous experience on the part of the instructors of several years with the same textbooks, and other considerations of organization and objectives.

Only the two weekly lecture periods were directly concerned with television presentation. Lecture sections normally involve groups of 120 to 200 students who meet together in the large chemistry auditorium. New material is presented and the lecture demonstration method is used. The lectures are considered to be the core of the course.

The lecture groups are split into groups of about 25 each for one period each week. These smaller recitation groups meet with instructors who are members of the senior staff. New materials are not ordinarily presented in recitation; instead, review, drill on problems, short quizzing on current work, and question-answer methods are used. The recitation instructor is responsible for determining the final grades of his students, based on performance in the recitation period, the monthly examinations, the final examination, and the laboratory grade.

The laboratory periods are devoted to experimentation by the students on a well-defined program of experiments which relate to the lecture materials. About two thirds of the laboratory work is spent on semi-micro qualitative analysis of selected metal ions. An entire lecture group meets simultaneously in the laboratory: graduate assistants supervise their work. Each graduate assistant is responsible for about 25 students, and a senior staff member supervises the overall group of students and assistants.

Nearly all students who take Chemistry 2 take further work in advanced chemistry courses. In general, they are students in scientific and pre-professional curricula, such as chemistry, chemical engineering, pre-medicine and the mineral sciences. They are second-semester freshmen. Since they have just completed the first course, Chemistry 1, quite complete data on their previous background in chemistry are readily available.

Since no attempt was made to use television in the laboratory or recitation groups, the possibility of finding significant differences between televised and control instruction is reduced. It must also be observed that learning may occur not only as a result of lecture demonstrations but also from the textbook, the laboratory exercises, and the recitation periods with respect to which all sections were treated alike.

The general plan was to divide the students enrolled during the spring semester into three groups, one of which would be taught in the originating room, while the second (divided into four sub-groups) would receive the lecture demonstrations over the television system in the receiving rooms. The third group which would constitute the control group would be taught in the originating classroom without television equipment present. The method of assigning students to these groups will be discussed later under the heading Scheduling of Students, 4-2-1.

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[1] This was a requirement of the basic research agreement.

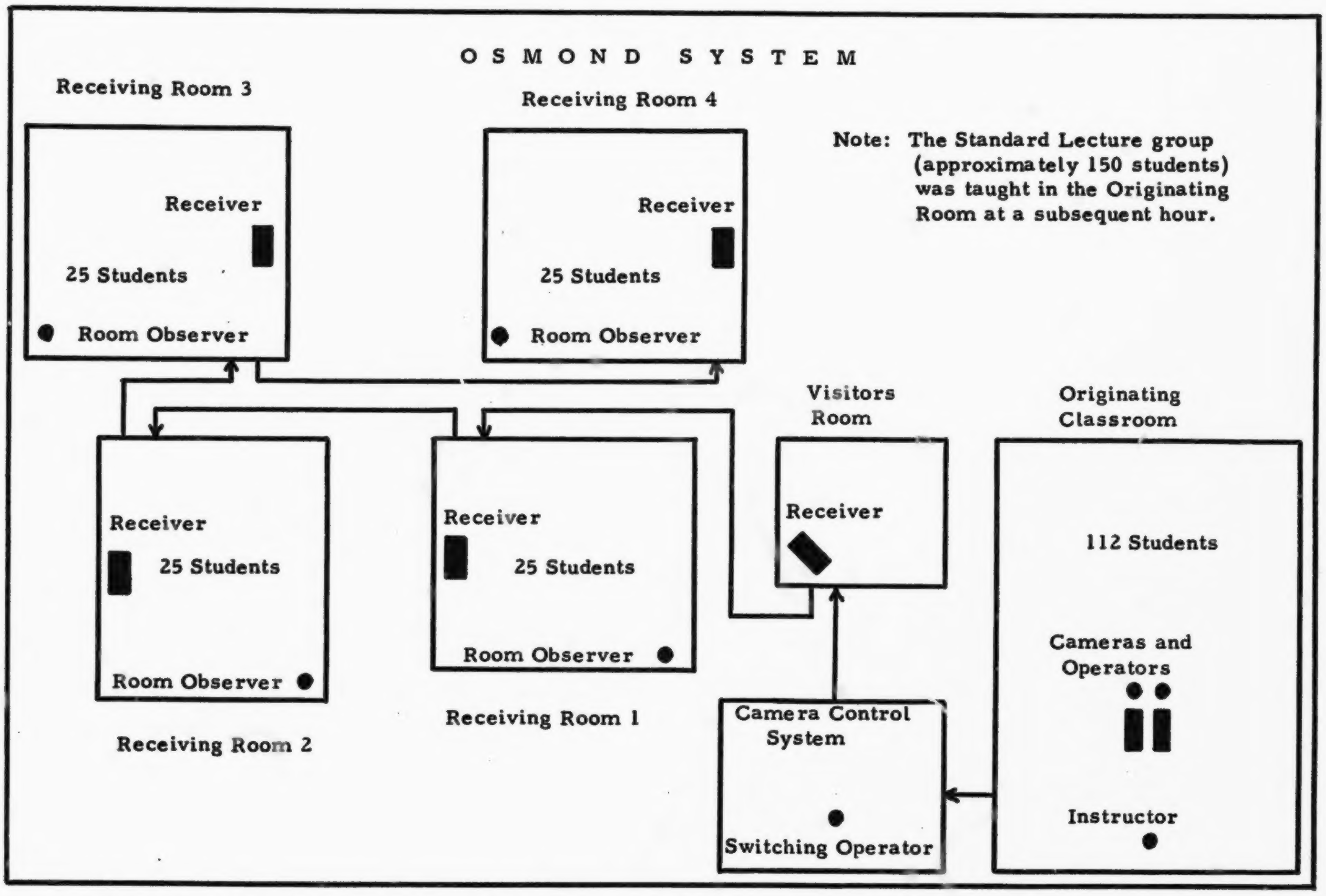

OSMOND SYSTEM
Receiving Room 3
Receiver
25 Students
Room Observer
Receiving Room 4
Receiver
25 Students
Room Observer
Note: The Standard Lecture group (approximately 150 students) was taught in the Originating Room at a subsequent hour.
Visitors Room
Receiver
Originating Classroom
112 Students
Cameras and Operators
Instructor
Receiver
25 Students
Room Observer
Receiving Room 2
Receiver
25 Students
Room Observer
Receiving Room 1
Camera Control System
Switching Operator

Figure 1. Distribution of General Chemistry Students to Rooms in Osmond Laboratory System

4-1-2 General Psychology

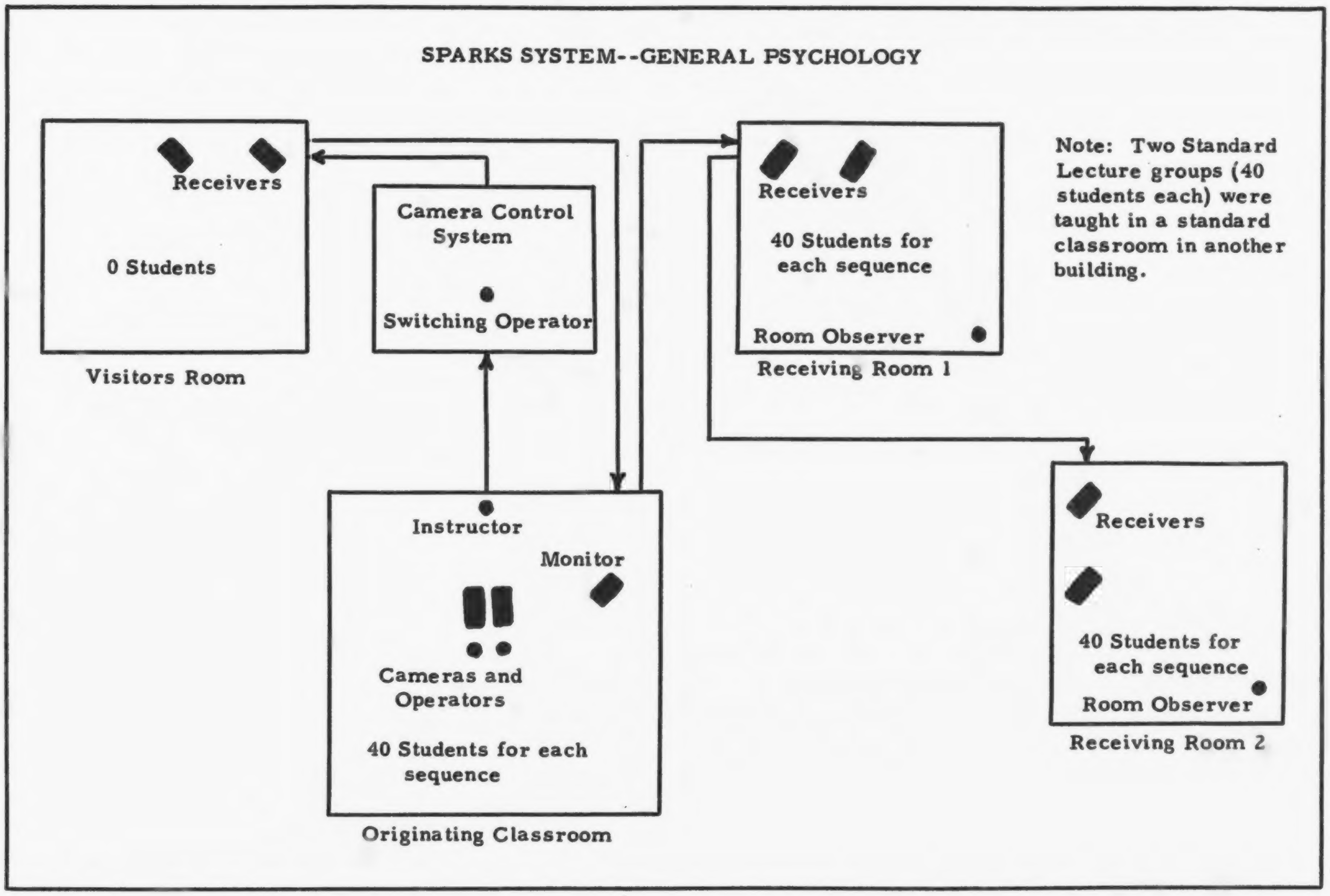
General Psychology is a one-semester three-credit lecture discussion course which meets for three one-hour lecture periods per week. Eight to nine hundred students may enroll for it in a semester. The course is usually taught to classes ranging in size from thirty-five to sixty-five. Since classes of about forty are the most common, it was decided to standardize all sections involved in the experiment to about forty students each.

Two principal instructors were selected. They agreed upon a general outline to be followed but each taught the course in the manner he thought appropriate.

While one instructor lectured to a group of about 40 students in the television originating room, and to two classes of 40 students in the television receiving rooms, the other instructor lectured to a control group of forty students in another classroom in another building. This control lecture was not televised nor was there any television in the room. Later in the day the instructors changed places so that the first instructor would teach a control class without television while the second instructor would lecture to students in the O-R and television receiving rooms. Thus each instructor taught under each of three conditions; control, television-originating situation and television-receiving classes. Of course, each class of students received all of the instruction under just one of three conditions. It should be noted here that the originating room was an auditorium with a capacity of 400 students, although only 40 students occupied it. The receiving rooms seated 40-50 students and the conventional class was taught in a different building in a classroom seating about 75 students.

While there were no laboratory or recitation periods as in chemistry, to obscure differences between treatments, all students studied the same text.

Figure 2. Distribution of General Psychology Students to Rooms in Sparks Building System


SPARKS SYSTEM--GENERAL PSYCHOLOGY
Receivers
0 Students
Visitors Room
Camera Control System
Switching Operator
Receivers
40 Students for each sequence
Room Observer
Receiving Room 1
Note: Two Standard Lecture groups (40 students each) were taught in a standard classroom in another building.
Instructor
Monitor
Cameras and Operators
40 Students for each sequence
Originating Classroom
Receivers
40 Students for each sequence
Room Observer
Receiving Room 2

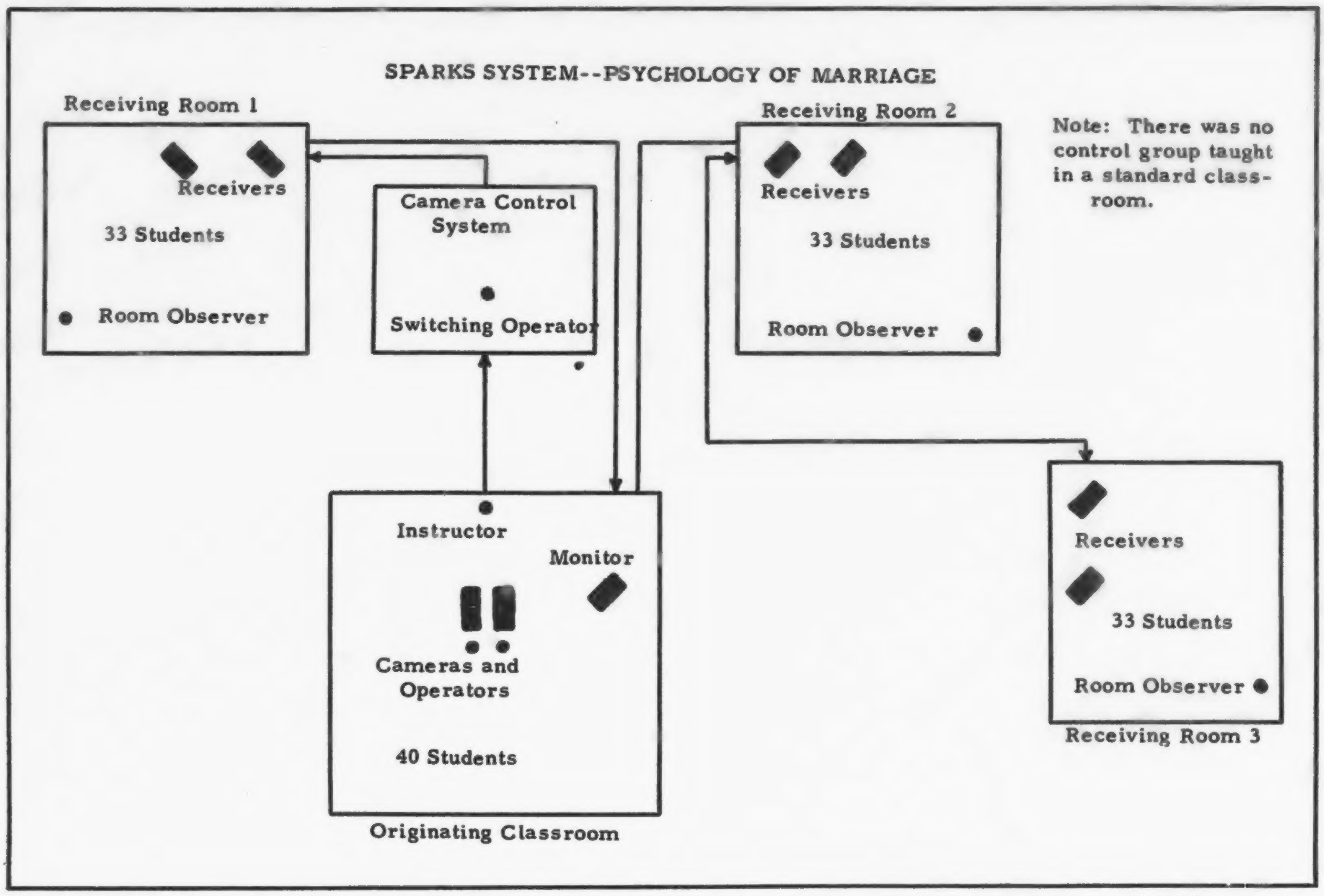

SPARKS SYSTEM--PSYCHOLOGY OF MARRIAGE
Receiving Room 1
Receivers
33 Students
Room Observer
Camera Control System
Switching Operator
Receiving Room 2
Receivers
33 Students
Room Observer
Note: There was no control group taught in a standard classroom.
Instructor
Monitor
Cameras and Operators
40 Students
Originating Classroom
Receivers
33 Students
Room Observer
Receiving Room 3

Figure 3. Distribution of Psychology of Marriage Students to Rooms in Sparks Building System

For any particular group, classes met at either eight o'clock Monday and Friday and one o'clock on Wednesday or at one o'clock Monday and Friday and eight o'clock Wednesday. Thus the design controlled for possible instructor differences, for class size and, to a large extent, for differences due to time of day and order in which the lectures were given. Also, the design permitted tests to be made of any interaction which might exist between instructors and methods, although this might be confounded with order of presentation to some extent.

4-1-3 Psychology of Marriage

The Psychology of Marriage is a one-semester three-credit course. It is normally taught by the lecture method in one section by one senior faculty member. This course was not included in the experiment as originally planned but since the enrollment for it was unexpectedly heavy and no other instructor was available to teach another section, it was decided to divide the class into four equal groups of about 30 each with one group in the O-R room and one group in each of three television receiving rooms. Students were assigned randomly to the two treatments with the exception of eight students, the data from whom were not used in the results. There was no control group which received the lectures without the television equipment and operators being present.

4-1-4 Comparisons Possible for Each Course

In both General Chemistry and General Psychology comparisons could be made among the following treatments: (1) those receiving the lectures over the television system, (2) those receiving lectures in the same room as the instructor with television equipment present, and (3) those receiving the lectures in the same room as the instructor (the control group).

The Psychology of Marriage course was designed to permit comparison between the television originating room and the television receiving room classes.

4-2 SCHEDULING OF STUDENTS

An extremely important control in the experiment had to do with insuring that students in the various sections were equivalent in terms of initial ability, interest, previous knowledge, and other characteristics which might influence their test results or learning scores. It is clear that we can neither isolate nor accurately measure all of these characteristics.

In each of the psychology courses an attempt was made to assign students randomly to groups so that each student had an equal chance of being assigned to any one of the different groups. With the large number of students involved in each course, the probability is very high that such random distribution resulted in equivalent groups. Furthermore, there are some objective data, to be presented in the section on Results, which indicate that this random distribution did, as a matter of fact, result in equivalent groups. Since the two psychology courses differed somewhat in their organization, a different procedure for randomizing had to be employed for each. The method of assignment of students to the various lecture groups in chemistry was quite different from that in psychology. These procedures are described in detail in the next section.

4-2-1 Scheduling of Students in General Chemistry

Since random assignment of the students to the various experimental groups was impossible in Chemistry 2, a matching procedure was used to obtain equivalent groups based on two principal factors: (1) curricular designation (assigned in the Time Table), and (2) final grades in the preceding course, Chemistry 1.

4-2-1-1 Curricular Designation. The two largest curricular groups were distributed among four lecture sections. These were the chemical engineers and the pre-medical students.

Four curricula of smaller enrollments were distributed between two sections as follows:

Medical Technician	Sections 1 and 4
Pre-Veterinary	Sections 1 and 3
Physics	Sections 1 and 3
Chemistry	Sections 2 and 4

All of the other curricular groups involved relatively few students each, and these were assigned to one of the four sections in the Time Table.

Sections 1 and 2 became the experimental groups, Sections 3 and 4 became the control group. Sections 1 and 2 met at a common hour for lecture. This arrangement gave complete freedom in making assignments of these students to either the originating room or to one of the television receiving rooms. The former met in 119 Osmond Laboratory, and received the lectures directly as the lecturer gave them, but with the television equipment present. The television group, of the same total viewing size as the "live" group, was distributed among four classrooms in the same building, and viewed and heard the lectures and demonstrations over the television receivers.

Sections 3 and 4 met at different hours and received the lecture demonstrations in the usual way.

Sizes of the sections were:

Sections 1 and 2, 120 students each
Sections 3 and 4, 100 students each

4-2-1-2 Designation on the Basis of Grades in Chemistry 1. Practically all of the students enrolled in Chemistry 2 had taken the Chemistry 1 course in the preceding semester (Fall semester). Their grades in Chemistry 1 (both final course grades and final examination grades) were used as the basis for making assignments within sections 1 and 2, which met at the same lecture hour. Students of equal standing in Chemistry 1, within each curricular group, were distributed equally between the originating room and the receiving room for lectures. For example, all chemical engineering students registered in sections 1 and 2 were divided into two equal groups in which the numbers of students of each grade designation —3, 2, 1 or 0—were balanced as equally as possible. Other curricular groups were assigned similarly so that the originating room and the receiving room classes represented, so far as possible, equivalent abilities and similar interests.

This procedure also permitted the assignment of recitation groups for sections 1 and 2, such that each recitation group was composed of equal numbers of students from the originating room and the receiving room audiences. Similarly, the laboratory groups of sections 1 and 2 had both types of students, since they corresponded to the recitation groups.

Sections 3 and 4 were designated as control groups, since television was not involved in any phase of their work.

4-2-2 General Psychology

The most thoroughly and scientifically defensible method of randomization was employed for this course. There were two sequences in which classes met: Monday and Friday at 8, Wednesday at 1, and Monday and Friday at 1, Wednesday at 8. Within each sequence a student might be assigned to either one of the two television receiving rooms, or to the television originating room, or to the conventionally taught control class which was not being televised. They could be taught by either one or the other of two instructors. Students registering for General Psychology were required at the time of registration to have *both* of the sequences free. At the time of registration the student was given a card (from a randomized pack) which indicated to which room, in which sequence, and to which instructor he was assigned. The unused sequence was then released and the student could schedule another course.

Students who could not have both sequences free or who were unwilling to participate in the experiment could schedule the course in one of four generally less preferred Tuesday, Thursday, Saturday sequences. There were a few cases (about 10) of students who were required to take the course yet who could not have both sequences free nor schedule it in the Tuesday, Thursday, Saturday sequences. In these instances, they were permitted to take the course but they were not considered part of the experimental population.

4-2-3 Psychology of Marriage

It was decided to televise this course and include it in the experiment after registration but before the first day of class. Neither an instructor nor classroom were available for a control group which would receive non-televised lectures. However, it was possible to assign randomly the students to one of three television receiving rooms or the originating room.

Since the students had not known when they registered for the course that they might be assigned to a television viewing room, the instructor felt that students who objected to this should be permitted to attend the lectures in the originating room. Eight students, assigned in the randomization to viewing rooms, requested transfer back to the originating room. This was permitted but their data were omitted from the analysis of results.

4-3 SELECTION OF INSTRUCTORS

These criteria were used in the selection of television instructors:

(1) that they be faculty members with extensive experience and acknowledged competencies for teaching these experimental courses and,

(2) that they have sufficient time and interest to participate in the experiment.

All the instructors who participated were highly competent.

4-3-1 Role of Instructors in General Chemistry

The three instructors in the Chemistry 2 lectures were men who had had previous experience in lecturing for this course.

Their responsibilities included:

1. The planning of the order of presentation of materials.
2. The preparation of the individual lectures and demonstrations.
3. Participation in planning sessions and regular weekly staff meetings.
4. The primary responsibility for the preparation of the three monthly examinations and the final examination.
5. Observation and reporting of reactions of students, as well as their own reactions to the course.

Each lecturer assumed full responsibility for one-third of the lectures. They appeared in rotation; i.e., lecturer A presented three lectures to all groups; lecturer B then presented three lectures. When lecturer C had completed a similar series, A took over for his next series, and so on. Each lecturer thus appeared for three series during the term. Each lecturer gave his lecture three times—once to sections 1 and 2 (the experimental groups) and once each to groups 3 and 4 (the control section), making a total of 27 lectures.

The plan of operation outlined above gave assurance that each student in all lecture groups received the same lectures and demonstrations from the same instructor. It also meant that each student received instruction in the lecture phase of the course from three different experienced lecturers. In this respect the procedure differed from the conventional one, in which a given student has only one lecturer throughout the course.

This plan gave each of the lecturers a period of time for preparation of his materials and demonstrations, since he was "off duty" while each of his two colleagues was presenting his series. An added advantage from the instructor's standpoint is that he was able to observe the presentation of the others as it appeared on the television screen and thus gain an added knowledge and appreciation of the procedure and effects from all angles.

In order to compensate for the added time involved in preparation, since this type of presentation was novel to his experience, each lecturer was credited with a teaching-load equivalent to the full lecture load for the course.

4-3-2 Role of Instructors in Psychology

The psychology classes were taught in an instructor-content-centered manner. Care was taken to insure that the television facilities were at the service of the instructors and not they at the service of the facilities. This meant that within very broad limits each instructor was free to teach the course in the manner he thought most appropriate.

It was hoped that within this free situation instructors would attempt to capitalize upon the potentialities of television. Occasionally instructors deviated from their usual methods in recognition of the fact that television offered new ways of presenting their materials. In general, however, it seems fair to conclude that the courses were conducted much as they had been previously with little effort made to capitalize on the advantages or to minimize the disadvantages of television.

It must be recognized, however, that one limitation imposed upon the instructors by the design of the experiment may have had a great deal to do with their failure to modify the courses for this new situation. That was the requirement that whatever was taught for the television sections must also be taught for the control sections. This requirement raises a difficult problem in research methodology: that of comparing two techniques of instruction each of which may have its own unique advantages and disadvantages. If the instruction emphasizes one technique, taking into account its special advantages and disadvantages, then the other, being different, will suffer by comparison.

4-3-3 Roles of Observers for the Experiment—Chemistry

Four senior staff members who were familiar with the Chemistry 2 course were given the responsibility of observing in the classrooms in which the television receivers were located. Experienced instructors were selected for this purpose because it was felt that they would be best able to observe student reactions and judge the effectiveness of the presentation from the subjective viewpoint.

Their responsibilities included, in addition to the above, monitoring and adjusting of the receivers when required, keeping the attendance record, and filling out a brief report sheet of observations for each class period. The observers also participated in the regular staff meetings each week, and most of them were responsible for some of the recitation and laboratory phases of the course.

4-3-4 Roles of Observers for the Experiment—Psychology

A proctor or observer was assigned to each television receiving room for the psychology courses. Some of the observers were faculty members while the others were graduate teaching assistants.

The role of the observers in relation to the students was quite passive on purpose. They positioned and adjusted the television sets and they kept the attendance records. *They did not teach.* It was important that the results of the experiment not be confounded by the variable influences of the observers in conveying additional information to the students on the content of the courses. Consequently they were instructed not to answer questions which were related to the course. They could answer questions about the television equipment (but not the experiment), about the time and place of the next examination, and other procedural questions of this kind. Questions on the course material were referred to the principal instructor. A student in one of the television sections could have his question answered by submitting it in writing to the assistant, who then gave it to the instructor, or by going to see the instructor after class or during his scheduled office hours. The instructors could answer questions over the television systems and before their control classes. Very few questions were asked.

The observers did not act as disciplinarians, although their presence in the room doubtlessly had a controlling effect on some students.

The principal function of the observers was to record students' reactions and comments which seemed to be related to their interest and acceptance of learning by television; they noted good and poor aspects of the day's lessons; and made suggestions for improving the course by a better use of the medium in the future. In psychology the observers also recorded suggestions for examination test items.

5—Equipment, Space and Facilities

5-1 SELECTION OF TELEVISION CAMERA EQUIPMENT

One of the basic requirements of the current study was that "low or moderate cost" television equipment must be used in the interest of feasibility. The reasons for this were as follows:

(a) It was believed that for television to have a useful role in university teaching, not one system would be needed but a number of systems located in the various colleges on a campus. Therefore, initial cost is an important consideration.

(b) The equipment should be so designed and constructed as to allow operation and maintenance by the kinds of people who are usually available on a university campus. Such people might include faculty members with some television or audio-visual experience, and students who could serve as camera operators or maintenance engineers.

(c) The equipment should be portable and not easily damaged by semi-skilled operators. These considerations pointed to the use of equipment designed around the *vidicon* television pick-up tube rather than the standard studio equipment which uses the *image orthicon* tube.

Vidicon type television equipment currently falls into two broad classes which may be designated as "low cost" and "moderate cost."

5-1-1 Low Cost Equipment

The low cost equipment has, in general, been designed for industrial applications where remote viewing of various activities is desired. Such equipment usually consists of a camera with its own built-in electrical controls and a separate monitor unit for viewing the picture. (The price of an industrial camera, a 14" monitor and accessories ranges from $1500 to $3000.) More often than not such cameras are "non-interlace" in their scanning which means that they do not give the maximum resolution possible with current television engineering standards. For all practical purposes this does not affect the definition of the picture very seriously, but it does prevent their use for broadcast operations. The low cost vidicon equipment is generally designed for single camera (rather than multiple camera) operation, and usually the camera is not equipped with an electronic viewfinder, the monitor being used for this purpose. Usually remote controls for the camera circuits, and for panning, tilting, focusing the camera and switching lenses are available, and some manufacturers provide an electronic viewfiender and a separate synchronizing generator to provide full 525 line scanning. These additions usually bring the equipment into the *moderate cost* class.

5-1-2 Moderate Cost Equipment

Moderate cost vidicon television equipment (costing $8,000 to $15,000 for a complete two camera chain) is designed for heavy duty studio operation, and is suitable for broadcast use. It is normally supplied in a "dual camera chain" which includes two cameras with three lenses on turrets, two camera control units, a synchronizing generator and a switching unit plus necessary power supply units. Where it is desired to send out sound as well as picture, and audio-video mixer is added to the system. This equipment is available in separate portable units, or with the control units and power supplies mounted in a console.

In general, the units correspond in function to those used in standard commercial image orthicon systems but scaled down in size and price. (Comparable standard image orthicon equipment would cost $35,000 to $45,000.) The moderate cost dual camera chain in conjunction with its switching unit is extremely flexible to use, and gives a high quality picture which is suitable for broadcasting as well as closed-circuit operation. This equipment may be employed for "limited range broadcasting" when used in conjunction with a low power (50 watt) transmitter now available, or it may be used to supply programs to commercial stations. Also, because of its functional similarity to standard studio equipment, the moderate cost vidicon camera chain is very suitable for student training.

5-1-3 Type of Equipment Selected

The Director and Associate Director of the Penn State Television Project visited the plants of five of the principal manufacturers of vidicon television equipment and saw demonstrations, usually of experimental models of their various units. They also inspected other makes of vidicon equipment at an exhibition sponsored by the Instrument Society of America, and arranged for some demonstrations to be given at the University.

Finally it was decided to use Dage equipment manufactured by Dage Division, Thompson Products, Michigan City, Indiana. A further decision was to use *moderate cost* equipment (the Dage "Professional" model) rather than low cost equipment in the regular televising of actual classes because of its flexibility and superior performance. However, two low cost systems (Dage "Industrial" model 60A) were obtained in addition for testing in a variety of other applications on the campus.

5-1-4 Advantages and Disadvantages of Vidicon Equipment

Equipment built around the vidicon camera tube has a number of advantages and disadvantages when compared with image orthicon television equipment.

Advantages of vidicon equipment:

(a) Lower initial cost of equipment.

(b) Can be operated and maintained by less highly skilled personnel than are required for image orthicon equipment.

(c) Lower maintenance cost. (The vidicon tube costs about one third of the price of the image orthicon tube ($350 versus $1200) and has a very much longer life (3,000 to 5,000 hours compared to 300-500).)

(d) More portable. The units are smaller and more easily moved from place to place.

(e) Less easily damaged. The vidicon tube shows little tendency for an image to "burn in" and cause permanent damage to the tube when held on static objects. This is a great advantage when semi-skilled personnel are required to operate the equipment. (The image orthicon tube has a tendency to burn in when held on a static object.)

(f) Uses less costly 16mm camera lenses.

(g) Gives better gray scale reproduction.

Disadvantages of vidicon. The principal disadvantage of the vidicon equipment is its relatively lower sensitivity to light as compared with the image orthicon camera. While it is sometimes claimed that "two to five" foot candles of light will give a picture with the vidicon tube, experience has shown that at least 50 foot candles of illumination are necessary for a minimally acceptable picture, and 150 to 200 foot candles (at a lens opening of f2.8) for an optimum quality picture. On the other hand, the image orthicon camera will give excellent quality pictures with 80 to 100 foot candles of incident illumination.

In the interest of compactness, elements of this type of equipment are generally somewhat crowded thus limiting accessibility, ventilation and cooling. Also, the systems used still had some "bugs" which are being eliminated by quality controls. Furthermore, maintenance is still a serious problem for the equipment in its 1954 state of development.

5-2 EQUIPMENT PURCHASED

5-2-1 Camera Equipment

Two complete Dage "Professional" model dual camera chains were purchased, one for the Chemistry-Physics Building (Osmond Laboratory) and one for the Liberal Arts Building (Sparks Building) where psychology classes were scheduled. One of these systems was purchased directly from the Dage Company under a special agreement. The second system, which was a used one, was bought from the Oil City Cable Company, Oil City, Pennsylvania. This latter purchase included a number of additional items of equipment, including a 16mm television film projector.

In addition, two low cost industrial television systems were secured from Dage.

5-2-2 Audio Equipment

For the instructor's use an Electro-voice Model 647 Lavalier type microphone was used. This is a small, lightweight microphone which is suspended on a cord around the instructor's neck, and is attached to his shirt front by a clip. It may be worn under the necktie. This type of microphone provided a high quality, uniform pick-up wherever the instructor moved and obviated the need for a microphone boom and operator.

Several other types of microphones were used in an effort to pick up comments and questions by the students in the originating room. No completely satisfactory solution was found for this problem which will be discussed further in a later section.

Dage audio-video mixers were installed to supply a suitable audio signal to the receivers. One of these was used with each of the two Professional systems. In addition, a video line amplifier was found to be desirable in each system.

A complete list of the units used in a "moderate cost" and a "low cost" system together with prices is given in the appendix.

5-3 TESTS OF EQUIPMENT

The equipment purchased from the Oil City Cable Company was obtained during November 1954. Since the rooms to be used in the experiment were not available for equipment testing purposes, the equipment was temporarily installed in a room in a new chemistry building. Here it was available to the staff of the project, other faculty members, and student operators and student engineers in order to provide experience and an opportunity for testing its operation.[1]

Both of the Psychology 2 instructors who were to teach in the experiment used this closed-circuit television system for their last two classes in the Fall semester. Half of each class received the lesson in the originating room where the equipment was installed, the other half received the lesson in an adjoining room via the closed-circuit system. Observers from the Chemistry Department saw these trial runs. These were the only formal rehearsals held for the Spring semester's operations.

Late in December a staff member and two student engineers visited the Dage factory for four days of training. At this time they took delivery of the second Dage Professional camera chain and the two Industrial systems. These systems were checked out in the temporary installation, but a thorough operational test was not possible before classes began early in February.

5-3-1 Decision on Video Transmission

Early study of the problem of the transmission of audio and video signals over the cable system indicated that radio frequency (R.F.) signals would be most easily handled.[1] Following this procedure no modifications would be needed in standard television receivers (except for a small bridging transformer in each set). Therefore an audio-video mixer was used in the system to provide a signal similar to the kind of R.F. signal transmitted by a standard television transmitter.

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[1] Valuable assistance in setting up this equipment was received from the chief engineer of the Oil City Cable Company. This equipment was sold to the University at a very favorable price, and this was a material help to the program.

During the testing period R.F. was distributed with acceptable results to three 24" receivers in an adjoining room. However, when the equipment was installed in the buildings where the experiments were to be conducted, and where much longer coaxial cables (approaching 1,000 feet) were used, it was found that there was considerable variation in the quality of the picture at various points on the cables.

Undoubtedly this problem could have been overcome by re-aligning all of the receivers and by providing a distribution system similar to a community antenna system, but since time was critical it was decided to try modifying one receiver to accept a video frequency picture signal along with the R.F. audio signal. The results were so much better that it was decided to convert all receivers to accept the video frequency picture signal. These modifications were not difficult to make and required minor circuit changes in the receivers.[2] The quality of the picture then appeared to be uniform at all points on the coaxial cable, except that towards the end of the line there was little reserve of signal strength and the pictures tended to lack contrast. Accordingly, it was decided that a distribution amplifier should be included in the system. This considerably improved the contrast of the pictures at all points in the line.

Thus, in the final arrangement, the sound was supplied through the audio-video mixer and fed into the coaxial cable at radio frequency. The picture signal at video frequency came from the switcher through the distribution amplifier and was fed into *the same coaxial cable* through a "T" connector. The general quality of results of this method of distribution was most satisfactory, although there is some possibility that distribution of R.F. for both picture and sound may have advantages of simplicity if the systems are expanded to include a great many additional receivers.

5-4 Selection and Purchase of Receivers

A basic requirement of the project was that, as far as possible, available standard equipment, obtainable at the lowest possible prices compatible with acceptable quality, should be used. Thus, while large screen projection type television receivers would be desirable, their cost and other feasibility considerations ruled them out.

Inquiries indicated that at the present time receivers providing a 24" picture are the largest standard type that are currently mass produced. Accordingly, it was decided to use this type of receiver in the classrooms. Standard Westinghouse 24" table model receivers were selected.[3] These proved to be very reliable in operation, and were particularly suitable because of their rugged all-metal cabinet. Eighteen 24" and two 21" receivers (for use as monitors) were purchased. The first batch of receivers had standard picture tubes, but with the remaining receivers, aluminized picture tubes were ordered. These provided a more brilliant picture.

5-4-1 Receiver Modifications

The modifications made to the receivers to accept a video picture signal were referred to in the previous section. A standard R.F. audio signal was supplied to the receivers from the audio-video mixer. These receivers were designed for home use and under conditions of classroom operation it was considered that the sound had too much bass for good speech quality. Accordingly, at the suggestion of a factory engineer, a change was made in the value of the audio coupling capacitor in the receivers with good results.

5-4-2 Installation of Receivers

It was decided, on the basis of an initial test, that two 24" receivers would be needed in each psychology classroom where there would be 40 to 45 students. Figure 4 indicates the typical placement of receivers for the psychology classes in standard unmodified classrooms.

In chemistry, since there were to be only 30 students to a room, it was decided to install one 24" receiver in each chemistry classroom to be located at the front center of the room. Receivers were originally equipped with a 5" speaker mounted in the side of the cabinet. With two receivers in each room, the sound level was satisfactory for the psychology groups. However, with only one receiver in a room in chemistry, it was decided after two or three weeks that further modification of the sound system would be necessary. Accordingly, in each of these receivers the 5" speaker was replaced by an 8" speaker in a small baffle box mounted underneath the receiver and directed straightforward toward the class.

In the beginning of the project a requirement was set up that sound had to be good and that no compromises of sound qualities would be accepted. Equipment limitations including those of receivers, acoustic qualities of rooms and lack of time from engineers prevented the complete satisfaction of this requirement.

5-4-3 Mounting the Receivers

In order to locate the receivers at a convenient height, and to make them easily movable and accessible for servicing, special lightweight metal stands were designed and locally constructed from 1" angle iron (See Figure 4). These stands have adjustable legs so that the center of the

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[1] There are two portions of the frequency spectrum used in television—video frequency and radio frequency. Video frequency is that portion of the spectrum ranging from D.C. (zero frequency) to about 10,000,000 cycles per second. Radio frequency as applied to television transmission extends from about 60,000.000 cycles per second to upwards of 500,000,000 cycles per second. Thus, in order to broadcast the picture which is a video frequency, this frequency is superimposed on an R.F. carrier wave.

[2] A description of the receiver modifications is given in the appendix.

[3] Westinghouse Model H875T24C.

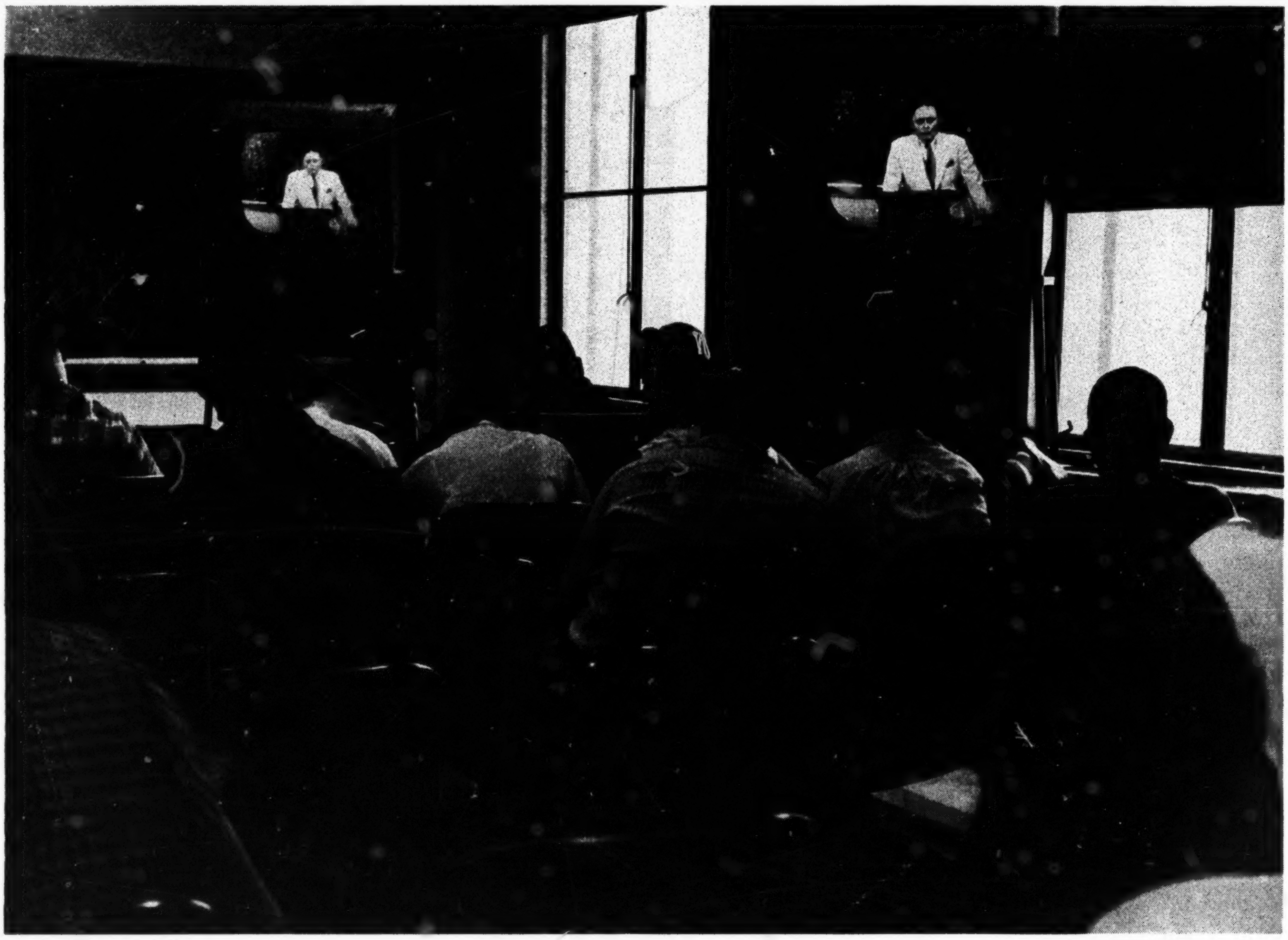

Figure 4. Arrangement of Receivers in Receiving Classrooms for Psychology Courses

screen can be varied in height between 4'6" and 5'6". The legs are splayed so that the stands can be stacked for convenient storage. The dimensions are such that, with the receivers in position, the stands can be wheeled through standard classroom doorways.[1]

Reflections on the faces of the receivers from the room lights and windows presented an initial problem. After some experimenting, several steps were taken to reduce or eliminate this difficulty:

(a) Hinged masonite hoods which projected forward about 15" over the top front of each receiver were installed.

(b) Each receiver was tilted forward by placing a piece of 2"x4" wood under the rear edge. (This tilt could be built into the stands, but it may cause difficulty in removing the chassis for servicing.)

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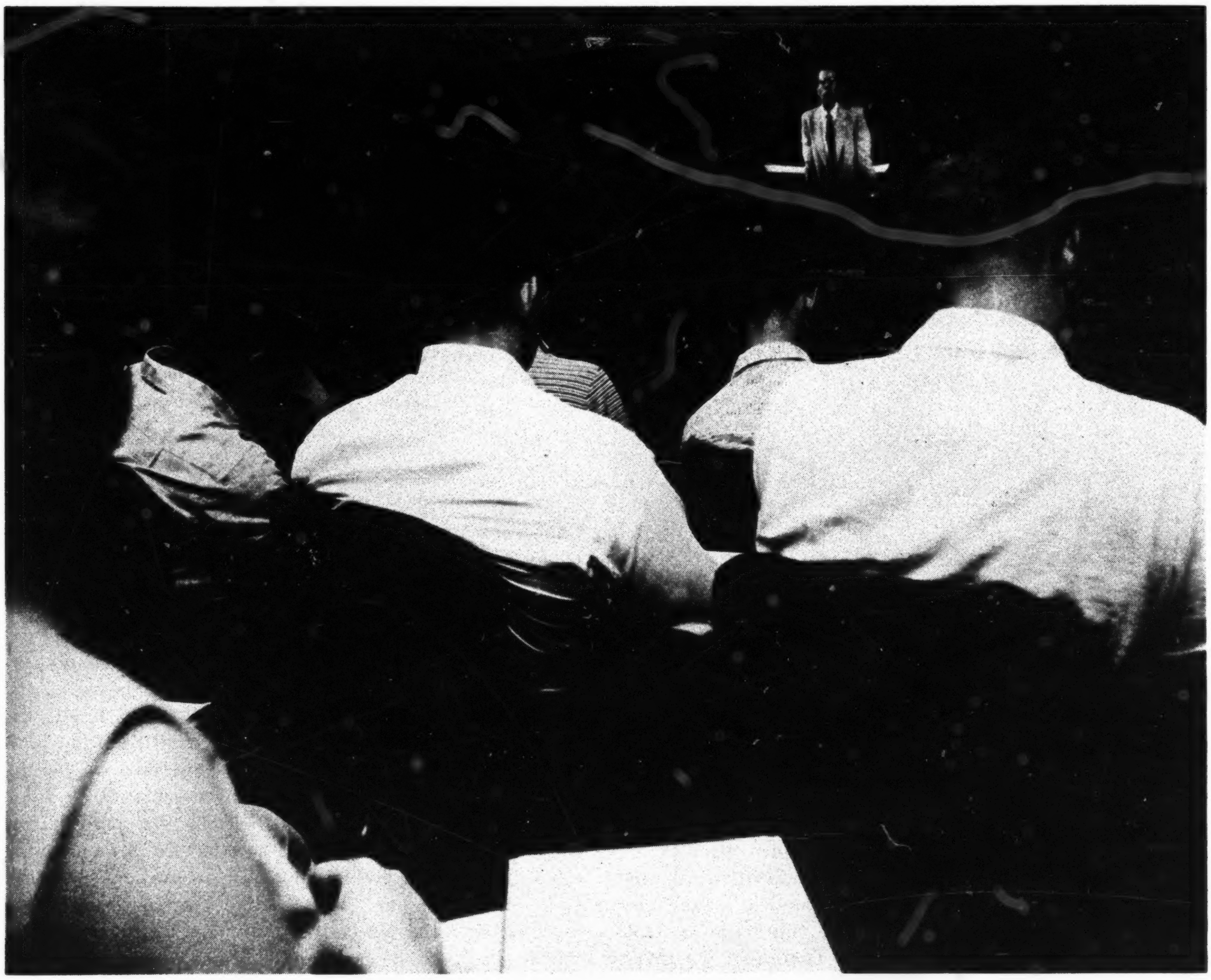
[1] The stands were made by L. V. McFadden, Spring Mills, R. D. No. 2, Penna.

(c) Where there were two receivers in a room they were placed on the window side of the room facing toward the class at a 45° angle.

(d) In the chemistry classrooms the window shades were drawn down and the room lights were kept on. This arrangement appeared to give the fewest reflections. In psychology the arrangement of room illumination varied from room to room.

Figure 5. Placement of Receiver in a Typical Chemistry Receiving Room



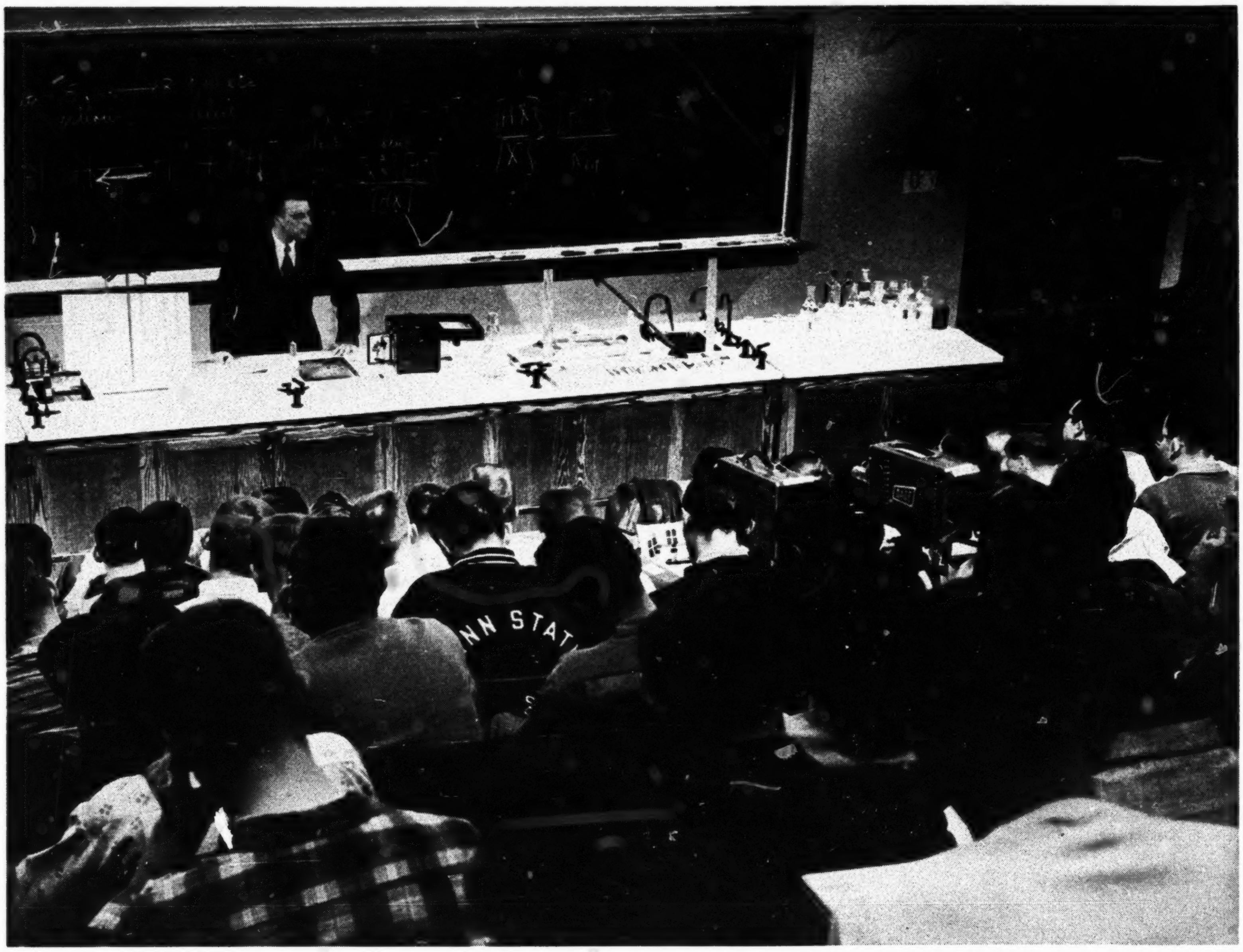


Figure 6. Chemistry Originating Room Showing Typical Placement of Cameras

5-5 INSTALLATION OF EQUIPMENT IN TELEVISION ORIGINATING CLASSROOM

5-5-1 Location of Cameras

In installing the television camera equipment in the originating classrooms, the general rationale was that the equipment should be as inconspicuous as possible. Furthermore, since normal classroom procedures were to be televised (without special adaptation to television) it was decided that the cameras should be located in a fixed position which would correspond to the "optimum student viewing position" in the classroom. Therefore, whatever would be seen and heard by the students who would normally sit in this position would be seen and heard by the students in the remote receiving rooms. Accordingly, the television cameras were mounted on small specially built tables located in the fourth row of the two originating classrooms—approximately 24′ from the instructor's table and 30′ from the blackboard. From this position the full length of the blackboard and lecture demonstration table could be covered without obstruction. (See Figures 6, 7 and 12.) The cameras were located so as not to interfere with the vision of the students in the originating rooms.

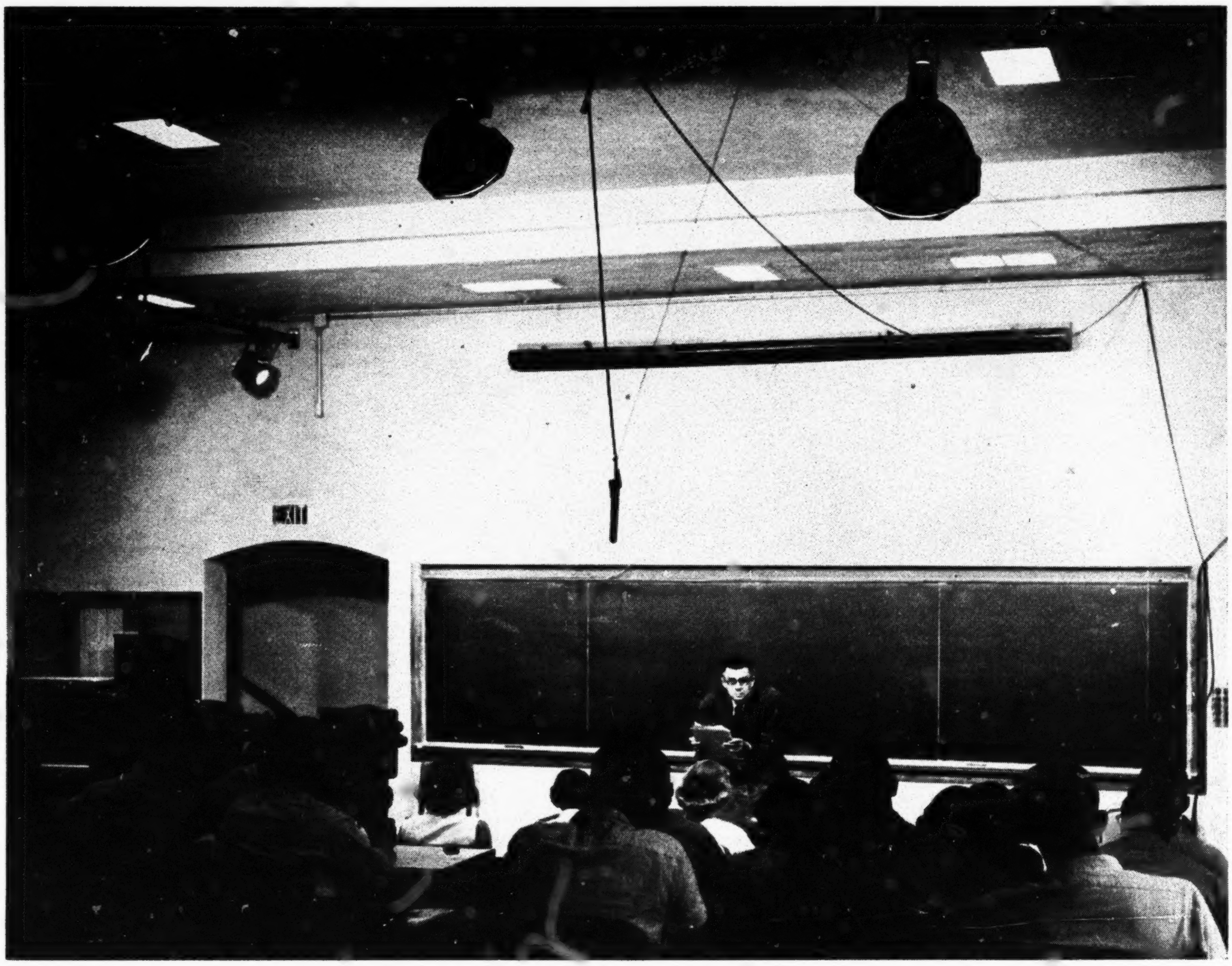


Figure 7. Psychology Originating Classroom

5-5-2 Number of Cameras and Lenses

Initially it was thought that one camera in each classroom would be sufficient, but this necessitated either blank periods on the screen while lenses were rotated on the turret, or the use of a "zoom" type of lens which permits a larger or smaller area to be televised by simply moving a lever. On the basis of observational evaluation (by students and faculty) of several trials it was decided that short blank periods during lens changes were distracting and that the zoom lens available was not sharp enough at an opening of f2.8 to give an adequate picture particularly for blackboard work (some more recent designs of zoom lenses show promise of being satisfactory). In view of these considerations two cameras were used in each of the two originating rooms. These cameras were mounted side by side, and each was equipped with three lenses on a turret (1″, 2″ and 3″ lenses).

With this arrangement it was possible to use one camera for long shots and the other for close-ups, or to have one camera on while the lenses were being changed on the other. In addition, the availability of two cameras provided a safety factor in the event of a breakdown with one camera.

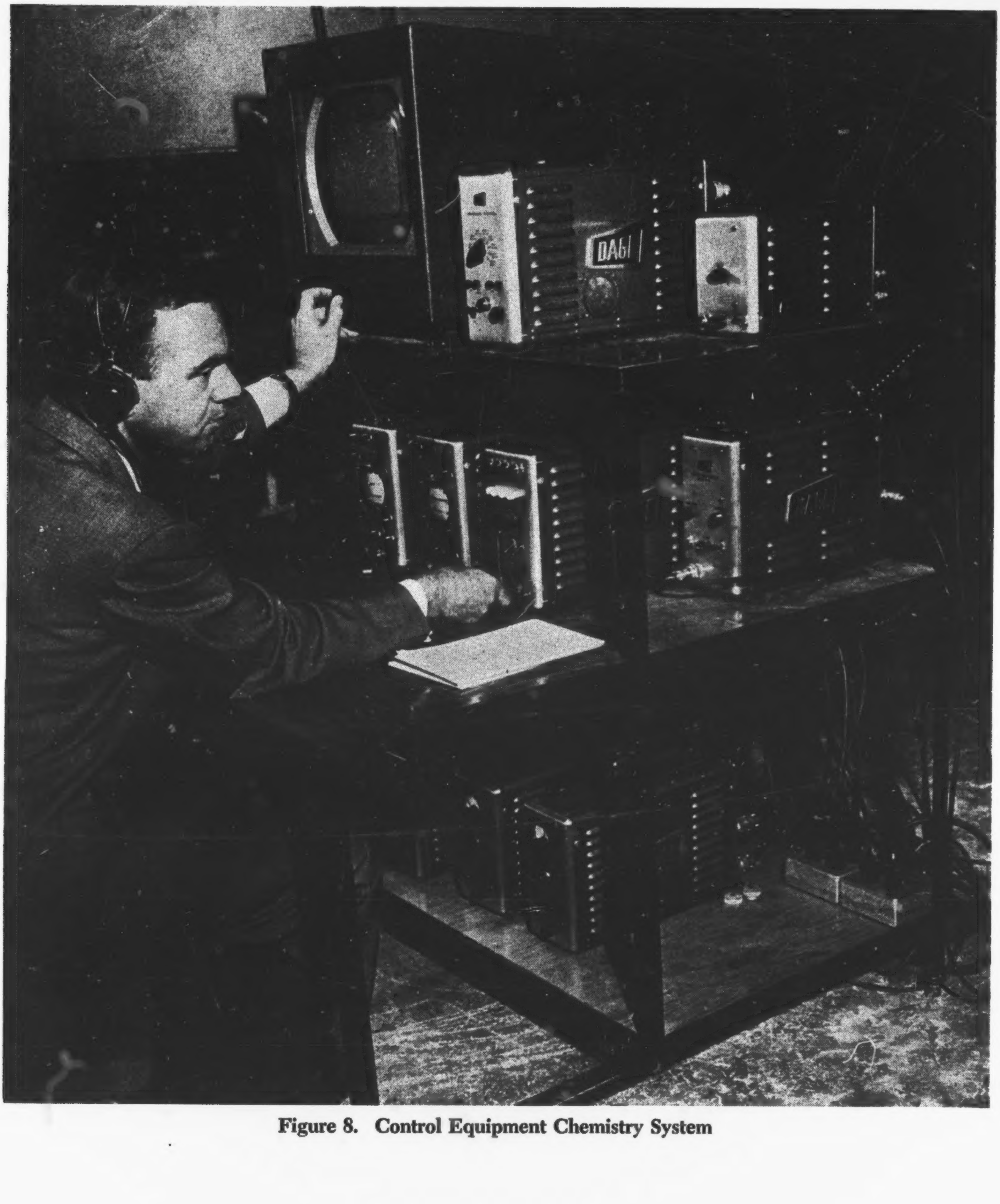


Figure 8. Control Equipment Chemistry System

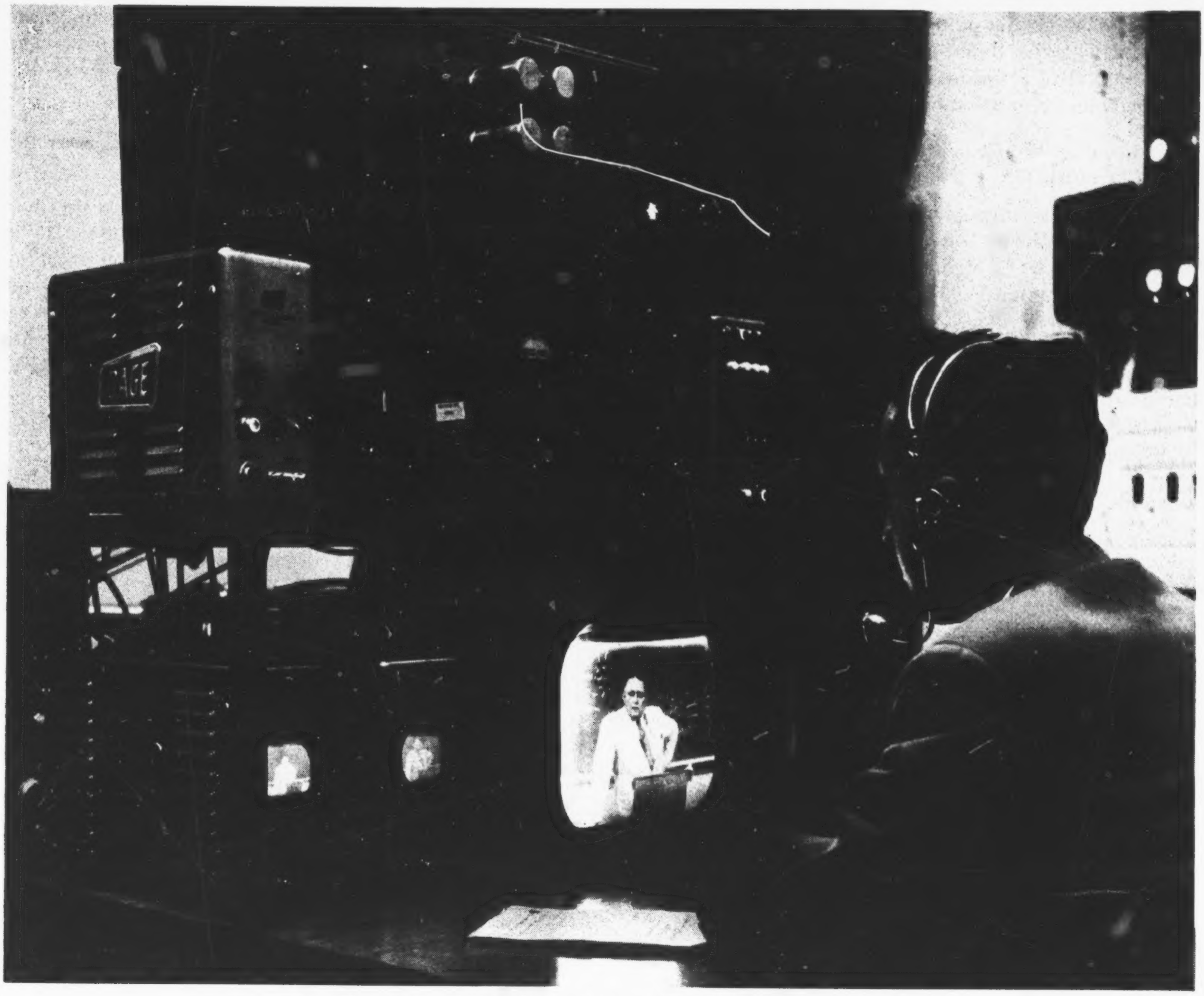


Figure 9. Control Equipment Psychology System

5-5-3 Location of Control Equipment

It was thought to be impractical to leave the camera control equipment in the originating classrooms between sessions since the rooms were used for other classes and the equipment would be inaccessible for servicing. Also, moving it after each class would be inconvenient. Accordingly, a small area was developed near each classroom where the control equipment could be located and operated.

Chemistry. In the Osmond building (for Chemistry) a space was found in the plenum chamber of the ventilation system immediately underneath the elevated seats in the lecture auditorium to be used as the originating classroom. This was very convenient because the control equipment could be located close to the cameras, and the equipment was accessible for testing and repair at all times. The control equipment (two camera controls, switching unit, audio-video mixer, synchronizing generator, power supplies and a monitor) was mounted on a simple type of console. (See Figure 8.)

Psychology. In the Sparks building (for Psychology) the control equipment was placed in a room which houses the University's F.M. transmitter. While this location necessitated the use of 100′ instead of 50′ camera cables, it was otherwise satisfactory. In this room the 16mm motion picture television projector was also installed so that films could be used in the psychology courses. Substantially the same control equipment was used here as in chemistry except that an audio-mixer was added to the system so that the input from several microphones and the sound film projector could be "mixed" and fed into the audio system. (See Figure 9.)

Initially one of the professional type television cameras was used with the 16mm film projector system. Later it was found that a low cost type of camera with minor modification was quite satisfactory for film pick-up uses.

5-5-4 Location of Microphones and Monitor Receiver for Chemistry

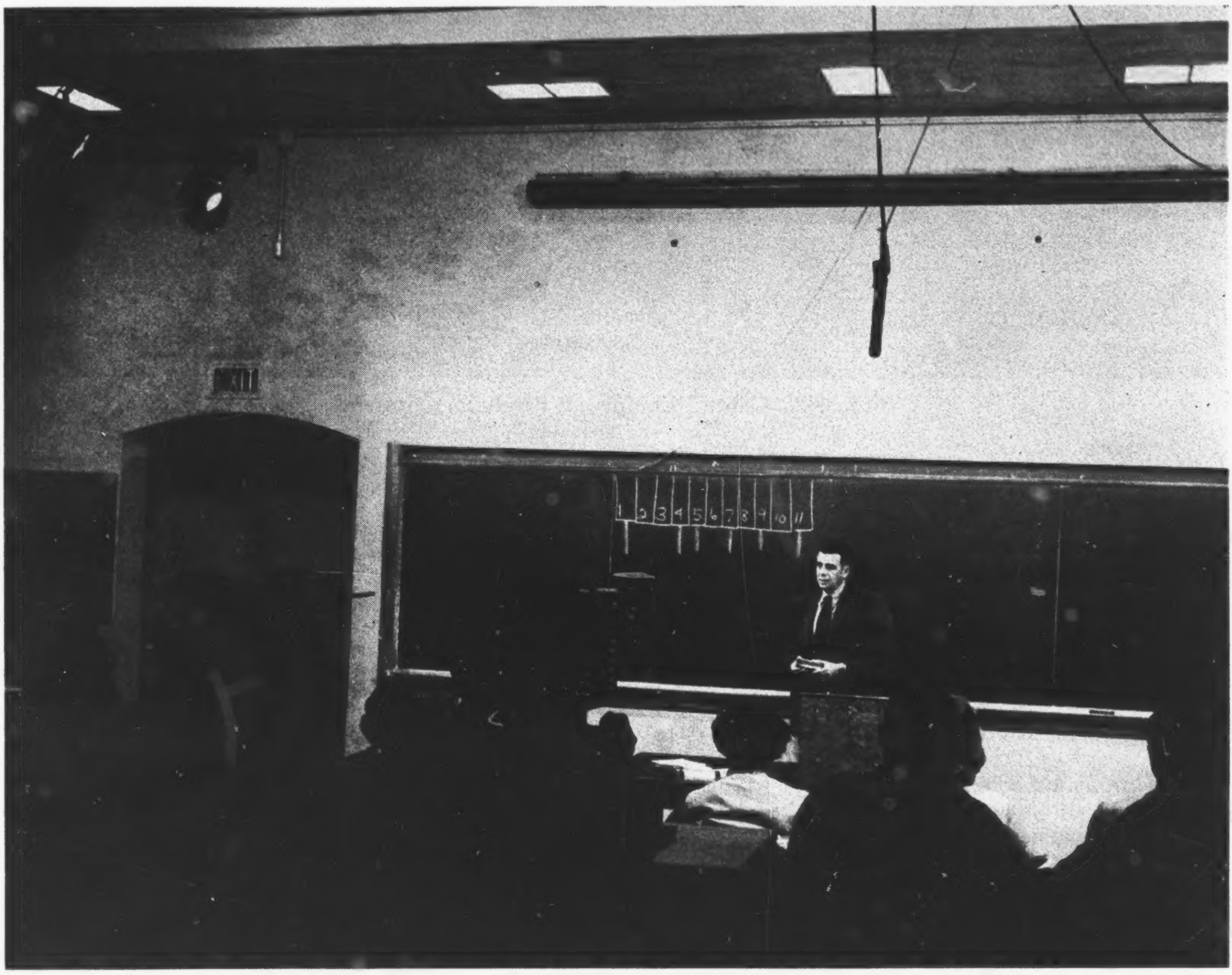
A small chest microphone was provided for the instructors. An Electro-voice Lavalier type dynamic microphone (Model 647) of low impedance was used. This was completely satisfactory since it was inconspicuous (it could be worn under the necktie), allowed free movement and gave a uniform level and high quality pick-up. In chemistry this was the only microphone used, since very few if any questions were asked by the students in these large section classes.

Also, a 24" receiver was installed in the originating classroom so that the instructor could see how his demonstrations appeared on television. This monitor was found to be unnecessary in chemistry and its use was discontinued.

5-5-5 Location of Microphones and Monitor Receiver for Psychology

A chest type microphone was also used by the psychology instructors and a monitor receiver was provided in the originating classroom. An additional requirement in psychology was that questions from the students in the originating classroom should also be picked up and sent out over the television system. Several types of microphones and positions of placement were tried. First, dynamic directional type microphones were located on short booms on each side of the class, and later a sensitive omni-directional microphone was suspended over the class

Figure 10. Psychology Originating Classroom Showing Placement of Microphone to Pick Up Students' Questions



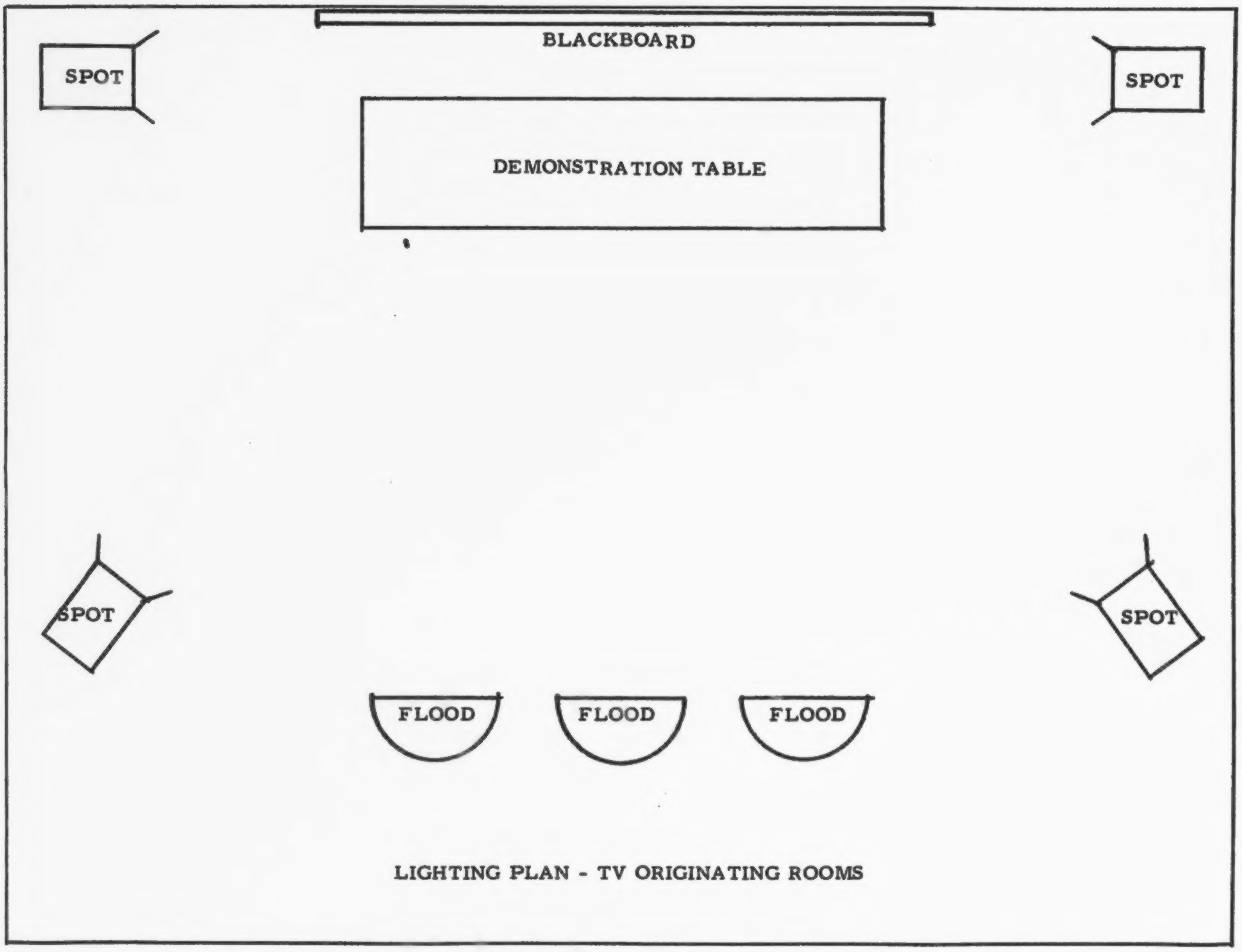


Figure 11. Lighting Plan—TV Originating Rooms

on a cord from the ceiling. (See Figure 10.) Unfortunately, neither of these solutions was entirely satisfactory. There appeared to be two problems:

(1) With 40 students grouped in a large 400-seat classroom, much of the sound was "lost" when a question was asked.

(2) The students appeared to be "mike shy" and asked fewer questions than usual, and when they did ask a question or make a comment, they tended to speak in a lower than normal voice.

There are several possible solutions to this problem which will be studied further.

5-5-6 Lighting for Television

As a result of early experimentation with the vidicon cameras it was found that between 150 and 200 foot candles of illumination (measured with a Norwood incident light meter) was desirable for optimum quality pictures using a lens aperture of 2.8 (the maximum opening of the 3″ lenses). In addition, the lighting should not be all from the front; side and back lighting were found to be essential to give a picture of adequate brilliance. For the same reason incandescent lighting fixtures were used in preference to fluorescent units, especially since the fixtures had to be located at some distance from the subject. As a result of early trials a lighting pattern was evolved using seven lighting units, three floodlights ("scoops") and four spotlights located as shown in Figure 11. The two spotlights located forward of the instructor's desk provided "modeling" light of fairly high contrast. The two units located near the front wall spread onto the blackboard and desk. These gave side and back light. The three scoops in front gave an even basic illumination to the area. The overhead lights already in the room provided sufficient top light.

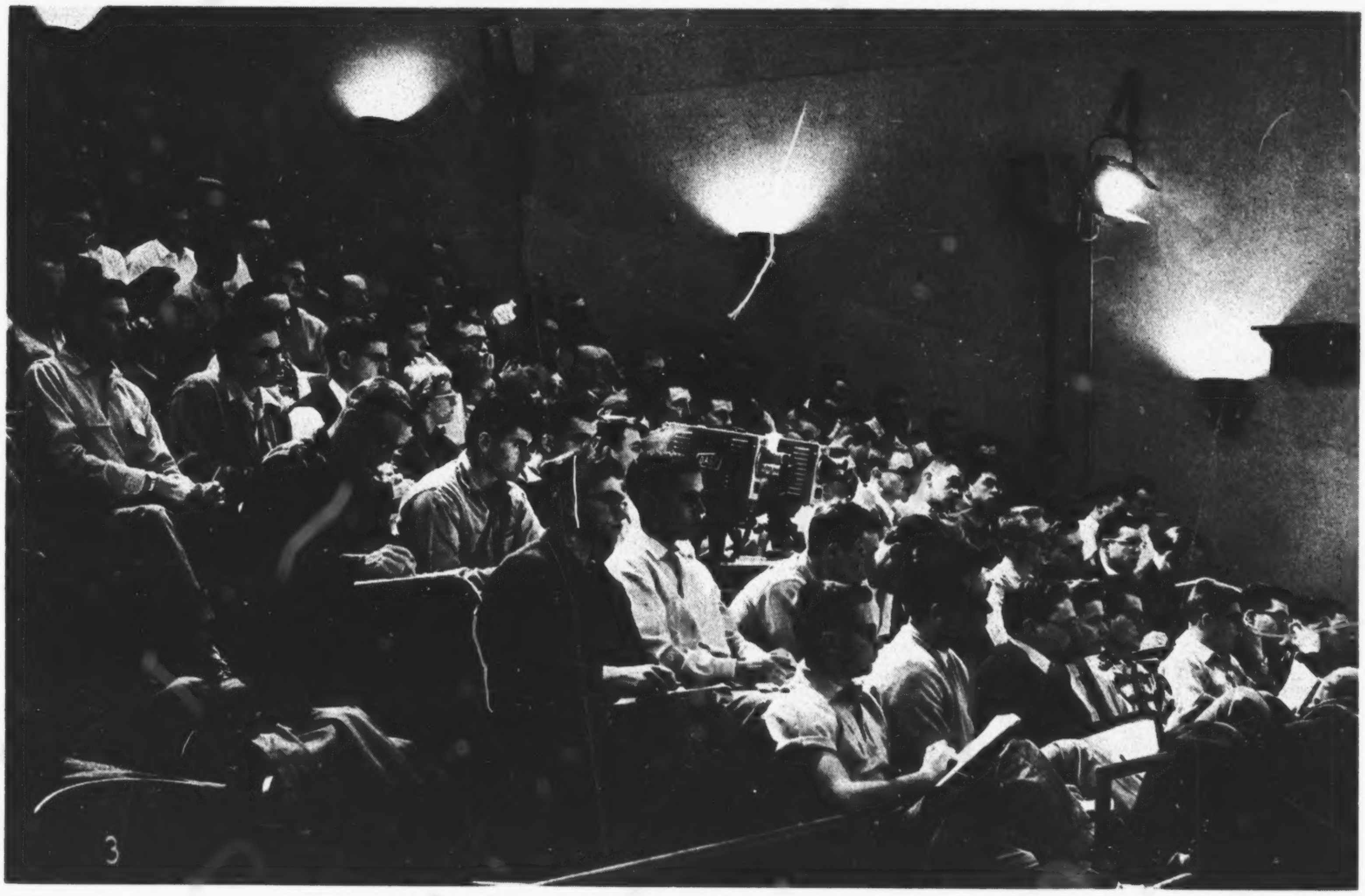


Figure 12. Originating Classroom Chemistry

The same pattern of lighting was used in both the chemistry and psychology originating rooms. Since the lamp-to-subject distances were greater in the chemistry lecture room, higher wattage lamps were used in those units. In chemistry the four spotlights were 2000 watts each and the scoops 1500 watts each. This arrangement provided 200 foot candles of even illumination over the full length of the blackboard and lecture table (about 25′). In psychology 750 watt lamps were used in the spotlights and two 1500 and one 500 watt lamp in the scoops, giving 175 foot candles of illumination. (See Figure 7.)

Since the ceiling was comparatively low in the psychology lecture room the lighting units were fixed directly to the ceiling. In the chemistry auditorium, however, it was necessary to mount the four spotlights on wall brackets some 14′ above the floor, and to hang the scoops on a 2″ pipe suspended from the ceiling by wires attached to a windlass. This permitted the lights to be raised and lowered.

Special power lines were provided from the transformers in the buildings so as not to overload existing circuits. Special electrical outlets were also provided in the control rooms for the camera equipment for the same reason.

5-5-7 Installation of Coaxial Cables

Two independent systems were used in separate buildings for chemistry and psychology. The arrangements for connecting the receivers in the viewing classrooms with the control equipment were similar in each installation. Coaxial cable type RG11/u was used for the main connections between classrooms. In each classroom a wall outlet with two BNC coaxial cable connectors was installed. The coaxial cables were laid in existing ducts in the buildings; they were not installed in special conduits, except where exposed in corridors, but care was taken to keep them away from steam pipes.

Within each classroom the receivers were connected to the wall outlets with type RG59/u coaxial cable. All of the receivers were in series on the same circuit, a bridging transformer being provided on each set. The last receiver on the line was terminated with a 75 ohm termination plug.

The existing A. C. outlets in the classrooms provided power for the receivers.

5-6 SCHEDULE OF INSTALLATION

The installation of cables, lighting and television equipment was done in the period of two and a half weeks between semesters (January 20, 1955 to February 4, 1955) and immediately prior to beginning the actual experiment so that there was no time available for "shakedown" operation in the actual situation of use. The installations were delayed by the time required to run cables, put in brackets for lights and other building modifications.

5-7 TOOLS AND TEST EQUIPMENT

A small kit of tools was purchased for use on the equipment. This included such common items as pliers, screwdrivers, adjustable and socket wrenches, soldering iron, drill, etc. The student engineers who worked on the equipment usually had tools of their own and preferred to use them.

It was found, in the course of setting up the equipment, that certain items of test equipment were essential. The items comprised:

(a) a good oscilloscope suitable for television work (a Tektronix 524D was used)
(b) a vacuum tube volt meter
(c) a volt-ohm meter
(d) NARTB television test charts

These items with prices are listed in the appendix.

5-8 SPARE PARTS

The types of spare parts and the number carried on hand depend largely on the accessibility of supply on short notice. Since the manufacturers of the equipment could be easily reached and spare parts received within three or four days it was decided to keep the stock on hand to a minimum.

It was found during the course of the study that the main kinds of spares needed on hand were vacuum tubes, resistors and capacitors. Accordingly, an inventory of the total number of tubes of all types used in the systems was made up, and at least one of every type and three or four of the more commonly used types were carried in stock for each system.

In addition, a small supply of resistors and capacitors was stocked, as well as one spare vidicon tube. Other items were purchased as needed from a local supply house.

6—Operation of the Television Systems

6-1 BASIC ASSUMPTIONS

A basic assumption was that for instructional television to be a feasible operation for a university it should be operated and maintained by personnel normally available on a university campus, and it should provide as far as possible an opportunity for faculty, undergraduate and graduate student training.

A second assumption was that "the instructor's autonomy in the classroom should not be violated." That is, the instructor should be in *full control* of the teaching situation, and not subject to the dictates of directors and technicians. Generally, such technical personnel as were available or necessary would be at the service of the instructors.

A third assumption was that the staff should be kept to a minimum in order to keep costs within feasible limits.

6-2 STAFFING THE TELEVISION OPERATION

In operating the closed-circuit system the following staff functions were performed:

(1) Engineering installation and maintenance
(2) Operation of cameras
(3) Operation of camera controls and directing of cameras
(4) General coordination of television facilities with instructor's needs
(5) Research on and evaluation of the operations and television systems

6-2-1 Engineering

The installation and engineering maintenance on the television systems were performed almost entirely by part-time student engineers from the Electrical Engineering Department.

Each of the two closed-circuit systems was staffed by an advanced student engineer, assisted by a less experienced engineer. Towards the end of the semester an additional undergraduate student engineer was added to the part-time staff in order to gain experience for next year's operation. The two principal engineers both received a short period of training (4 days) at the Dage factory.

Of the two principal engineers, one was a graduate student with extensive knowledge of electronic circuitry, the other was a sophomore who had radio station and military radio experience. Whenever possible a student engineer was on hand when a system was in operation.

The student engineers proved capable of handling most of the problems encountered. However, the work was done entirely on their free time from classes, which was at a premium toward the end of the semester. Thus there were periods when it was difficult for them to keep up-to-date with equipment maintenance. It is believed that a better arrangement would be to appoint one or two graduate assistants as engineers for the operation, e.g., one for each system. These men should give about 20 hours a week to the project and would train and be assisted by several less experienced student engineers.

During the installation and early operating phases of the systems valuable help was received [illegible] he Chief Engineer of the Altoona Television St[illegible] FBG-TV. Furthermore, as will be discussed below, [illegible] engineering assistance was received from the manufacturers of the equipment.

6-2-2 Camera Operators

Initially staff members, some of whom had limited experience with television cameras, served as camera operators, and trained others to perform the task. As soon as a core of experienced operators had been trained, students were invited to participate as camera operators. The method of training generally consisted of giving the student a brief orientation to the camera and then of having him sit and watch an experienced camera operator for one or two class periods.

The cameraman's principal jobs are to check the lens apertures, keep the camera lenses in focus, change lenses and follow action as directed by the camera controller. (See next section.) The mechanics of the job can be learned in about an hour. However an alert camera operator can be a great help to the camera controller and can materially aid the presentation of the lesson by being alert and ready to anticipate the instructor's moves and the controller's directions. This was especially necessary in chemistry where there was a great deal of action requiring close coordination between instructor, camera operators and camera controller. This skill comes with practice.

A further essential requirement is that the camera operators must be absolutely *dependable*—they must be on the job when they are scheduled for a class session. The usual procedure was to team up a student and a staff member. During the semester some ten students and five staff members were trained in camera operations. During two hours per week the systems for chemistry and psychology were operated simultaneously. This placed an additional load on the operators, but was accepted as a realistic situation which would apply to institutions using two or more systems.

6-2-3 Operation of Camera Controls and Direction of Camera Operators

The quality of the picture sent out through the system is dependent upon the adjustment of the camera's electrical controls. This is an exacting job and requires a working knowledge of what is involved in setting up a good picture. Just as the camera operator must learn the mechanical operation of his equipment, the camera control operator must learn how to obtain a picture of maximum quality from his cameras. When this has been thoroughly learned, the camera control operator then performs his main job—that of bringing to the viewing student a logical and smoothly conducted presentation. (The television viewing student is not expected to be familiar with problems involved in bringing him a good picture; he expects to be shown one as well as to be given the lecture demonstration in a clear, logical way.) The camera control operator must have complete cooperation from his cameramen and, as the lecture progresses, will call for the camera and lens combination required to show best the material being presented, and will select the picture to be sent to the receiving rooms by the operation of the switcher. Camera operators will often cue him on anticipated movements and introduction of new materials by the instructor. The instructor will very often do this himself. Consideration must be given to the students' needs and the camera control operator must decide how long to hold a scene on the screen, he must get optimum close-up views where important detail needs to be seen, and he must estimate how much time is required for students to take notes from material presented on the blackboard.

Effective presentation of a lecture demonstration over the television system requires close coordination between the instructor, the camera controller, and the camera operators. This is facilitated by the fact that the camera controller is in contact with the two camera operators by means of a two way inter-com system.

Two staff members of the Instructional Film Research Program, one for psychology and one for chemistry, handled the job of operating controls for the greater part of the semester. However, as student camera operators became trained, other staff members were trained in adjusting the camera controls and performing the control operations.

6-2-4 General Coordination of Television Facility with Needs of Instructors

The function of coordinating the instructors' needs with the television facility was generally performed by the camera controllers, although in the psychology classes an additional general coordinating function was performed by a research psychologist.

In general, it was understood that no course alterations or rehearsals would take place during this project. Classes were to be televised without change or extensive preplanning. Using this as a basis from which to present the course material, little coordination between instructor and production took place except where there was some doubt about how a demonstration would appear on television. This was especially true in chemistry where, periodically, experiments of an unusual nature were carried out. It was found that a few minutes' discussion with the camera controller before class about the material to be presented, or performing the experiment in question to see how it looked prior to actual televising to students was quite advantageous and resulted in a more effective presentation.

Due to the nature of the psychology course (it was primarily a straight lecture course with a fair amount of blackboard work) there was little or no necessity for such pre-planning before class convened. Aside from the camera controller, a research psychologist acted as an additional coordinator and generally made arrangements for the televising of films or slides.

Since psychology was virtually an all-lecture course, presentation of the material was quite straightforward. Most lectures were handled in the same manner. From an operational point of view, psychology instructors did not allow anything related to television to come between them and the face-to-face students. In this phase of the study, the television cameras actually were treated as two students in the classroom listening to the instruction. Some of the students in the viewing rooms have expressed the opinion that the instructors ignored them, and referred to them only when absolutely essential.

6-2-5 Operations Research and Evaluation

It was not possible to conduct systematic research on the advantages and disadvantages of various arrangements of the television system. However, continuous qualitative evaluations of the systems were made. These evaluations were made by students in the classes (in response to questionnaires about the television system) and by staff and faculty members. They covered such matters as the number of receivers to a room, the best placement of receivers to eliminate reflections, the evaluation of picture and sound quality after various changes in the system were made, the comparison of video and R.F. picture transmission, the handling of the cameras and the switching operations.

The need for a broader and more systematic approach to operations research and analysis is apparent.

6-2-6 Relations With and Assistance From Equipment Manufacturers

An agreement was made with the manufacturers of the Dage television equipment to the effect that they would provide training and engineering assistance when necessary and would supply the newest types of equipment. The Pennsylvania State University agreed to provide a research and development facility or "proving ground" for the equipment and to report to the manufacturer results of using the equipment in an educational context. Also suggestions would be made for modifications of the equipment and arrangements of assemblies.

Two student engineers and a staff member spent four days at the Dage plant in December, 1954, and two student engineers are spending two and a half months in the plant during this summer (1955). In addition, Dage engineers visited the project on three occasions and gave valuable assistance and training.

A service representative from Westinghouse visited the project early in the Spring semester and suggested a change in the audio system for the receivers, and gave guidance on the maintenance of the receivers.

6-3 TELEVISION PROCEDURES IN THE CLASSROOM

6-3-1 Classes Televised Without Change in the Course

As was stressed earlier in this report, the courses presented on television were not to be changed more than was absolutely necessary. For this reason fixed camera positions and fixed lights were used on the assumption that what the students in the originating room saw would also be seen by the students in the viewing rooms. Thus the cameras merely acted as onlookers and picked up what normally occurred and was visible to students in the classroom.

As a result of the semester's experience it is clear that one camera should be located, when necessary, close to the demonstration table where it could show equipment too small to be seen properly even in the live classroom or to be shown by the camera located 24 feet away. This procedure would take full advantage of one of television's greatest potentialities, the ability to give a close-up view. As a matter of fact this procedure was tried out during the final chemistry lecture demonstration with good results. It was possible to show a Wilson cloud chamber and the operation of a Geiger counter in such a way that students looking at a television receiver could see better than students actually looking at the demonstration. (During this last class receivers were also installed in the originating room so that the students there would not be at a disadvantage.)

In chemistry, slides were used from time to time and these were satisfactorily televised directly from the screen in the originating classroom.

6-3-2 Rehearsals

There were no rehearsals for each class in the generally accepted sense. As was indicated earlier the last four class sessions of psychology in the Fall 1954 semester were televised in order to familiarize the staff and instructors with the equipment. In chemistry a few of the demonstrations were tested out prior to class presentation and the camera controller usually obtained some idea of the topics to be covered during a lecture demonstration. Coverage of the lessons has sometimes been likened to television coverage of a football or baseball game in which the action occurs and is followed by the cameramen.

6-3-3 Special Adaptations

In practice it was found that a few special modifications of instructional procedures were needed:

(a) Use of the blackboard. It was found that for the writing on the blackboard to be legible on the television screens, the instructor should use only one panel (5 feet wide) at a time. If more than one panel were covered the reduction in size of the image on the television screens made reading difficult from the television receivers in classrooms. The instructors soon adapted to this requirement. It was also found that legibility was greatly improved if a soft grade of chalk were used. These procedures became standard in both psychology and chemistry.

(b) Avoidance of pacing. Instructors who were accustomed to pace backwards and forwards were asked to reduce this movement as much as possible, to stay at the lectern or move deliberately to the blackboard or demonstration bench when necessary and to slow down their movements when performing demonstrations.

(c) Checking chemistry demonstrations. In chemistry when there was some doubt as to whether a demonstration would be visible on television it was tried out ahead of time to see how it could best be picked up by the cameras. This applied to perhaps 15 per cent of the demonstrations. When actual colors of materials were considered to be of crucial importance, samples in test tubes were circulated both in the face-to-face classes and the television classes. Generally before the beginning of a chemistry class the camera controller would check with the instructor to find out what was going to be presented, where it would appear, and whether there would be any "fast" reactions which might be missed if the camera operators were not alerted in advance.

(d) Films for psychology. Generally films to be used in psychology classes were tested out ahead of time. However, since there were very few demonstrations given in psychology, few if any, test runs were made prior to class presentations.

It is clear however that some changes should be made in the method of presenting course material over television that would require somewhat closer collaboration between the instructor and the equipment operators, and that a brief run down of items to be covered at the next session could be discussed at the end of the previous class period.

Just as the engineers, the camera operators and the camera controller must have a thorough understanding of the capabilities and limitations of the television system, so must the instructor have a working knowledge and awareness of the many elements that are involved in conducting a successful television course. Close cooperation between instructor, camera controller, camera operators and engineer is vital for good television instruction. A four or five hour briefing session at the beginning of a semester for instructors who have not previously used television would probably be helpful in this respect.

7—Tests and Measurements

A project of this kind manifestly requires the best possible measurements of academic achievement in all of its phases. Ideal measures to be used for experimentation should be far superior to those regularly used in universities. However, the development of new, proven and validated measures of academic achievement and personal development is an enormously expensive, time and energy consuming task. Therefore, in terms of the limited resources and time available, new and improved kinds of measures could not be developed.

Furthermore, it will be recalled that for this project the instructors carried the responsibilities for the courses and this included the selection and/or approval of all measuring instruments. The project staff provided as much help as the instructors would accept in the development of achievement tests, selected a few extant and standardized measures and developed several new approaches to the assessment of attitudes.

7-1 OBJECTIVES OF THE COURSES RELATED TO MEASUREMENTS

Ideally it is desirable to have firmly established the general and specific objectives of courses and then to prepare measurements relative to these objectives. The objectives for the courses used in the television project were found to be largely implicit or subjective with the instructors rather than explicit or formulated in objective statements. Consequently, given this condition and without the enormous amount of discussion required to arrive at objectives of courses to which different instructors will agree, it was not possible in this project to have a statement of course objectives relative to which measurements could be applied.

The one general objective which could be agreed upon and accepted for all courses was that the courses should teach the student a body of appropriate information consisting of facts and principles. Therefore, the main efforts of all concerned were directed towards the measurement of the learning of such information. This is usual with university teaching.

Admittedly there are, or should be, a much broader range of educational objectives operationally built into university courses and curricula. These are often stated in idealistic terms. However, when it comes to the fundamental difficult task of determining quantitative evidence for the contributions made to students by specific courses, or even curricula, in terms of effects on their full academic and personal development, educators must generally admit failure.

For the Television Project efforts were made to measure as thoroughly as possible, within the context of the experiment, informational learning, relevant attitudes and opinions and some general changes in interests and judgments which might be assumed to be the effects of some of the courses.

7-2 MEASURES USED IN THE PROJECT

The formal measures developed for use in the study were as follows:

A. General Chemistry
  (1) Objective measures of student achievement
  (2) Student reaction schedules designed to obtain information about students' attitudes to televised instruction

B. General Psychology
  (1) Objective multiple-choice measures of student achievement
  (2) Student reaction schedules to televised instruction
  (3) Student ratings of psychology in relation to other courses
  (4) Attitude scale to measure the personal relevance of psychology as seen by the students
  (5) Attitude scale of attitudes towards psychology and psychologists
  (6) The F scale. This was used to measure any changes that might have occurred in students' attitudes in the direction of less authoritarianism.
  (7) The election of a future course in psychology

C. Psychology of Marriage
  (1) Objective measures of student achievement
  (2) Student reaction schedules to televised instruction
  (3) Marriage Happiness Prediction Inventory

Informal indications of acceptability and effectiveness of televised instruction were obtained from the logs of the instructors who taught the courses, the records of the receiving room observers, and by some informal discussions with students and faculty members. The measures will be described in this section, and the results will be given in Section 8.

7-3 MEASURES OF INFORMATION LEARNING

7-3-1 Chemistry

Four major examinations on course content were given. Three of these were one-hour tests given at regular intervals; the fourth was a two-hour final examination covering the work of the whole term. All students took the identical tests and examinations at the same time.

The tests and examinations were almost entirely of the multiple-choice objective type. Questions were designed to test knowledge of facts and principles, ability to apply principles, and to demonstrate understanding rather than simple recall, although some of the latter type were necessarily used. A significant portion of each examination dealt with chemical calculations. The final examination was designed completely for machine scoring, but otherwise it was similar to the one-hour examinations.

These tests were similar to those used in the course in previous years in both form and administration. They were prepared by the staff members responsible for the course, under the supervision of those instructors who gave the lectures. (Reliabilities of these tests are given in Table 1, page 44.)

7-3-2 General Psychology

Three one-hour examinations (65 questions each) spaced through the semester and a two-hour final examination (115 questions) were given in this course. The questions were all four-alternative multiple-choice questions which by inspection seemed to measure recognition of correct definition of terms, correct facts, and some principles. Many items appeared to be based primarily on definition of terms and concepts. The final examination tested material from the entire course, the hour examinations each covered three or four chapters of the text on which lectures had been given. The selection of questions for inclusion in the examinations was made by the two instructors. (The reliabilities of the tests are given in Table 2, page 45.)

7-3-3 Psychology of Marriage

Three one-hour examinations were given in this course; each examination covered about one-third of the course. All the tests were composed of multiple-choice and true-false questions based on the text and the lectures. The scores on the multiple-choice questions were multiplied by two and added to the score on the true-false questions to arrive at the total score. In general this meant that the true-false questions were given relatively little weight in the total score. The questions appeared to measure primarily the learning of extremely detailed information including a large number of statistics on marriage adjustments. A portion of the questions in each of the three tests could be answered only on the basis of the lectures, but these questions covered relatively minor points in the lectures. (The reliabilities of the tests are given in Table 3, page 46.)

7-3-4 Statistical Methods and Procedures

7-3-4-1 Chemistry. The reliabilities of the chemistry examinations were estimated by Kuder-Richardson Formula 21. In the development of this formula an assumption is made that all the questions are equally difficult. If this assumption is not justified, the obtained reliability estimate is below that which would be obtained if two forms of a test were correlated. The assumption was probably never justified in the case of the four examinations used in this course. This method of estimating the reliability of the chemistry tests does *not* tell how similar the scores of these students would be if the same test were taken a second time; it does indicate how similar the scores would be if a different set of items or the same material were used.

The means of the three groups in the experiment were compared by making an analysis of covariance of the scores on the four tests. The means of the tests for each group were adjusted statistically for differences between the means of the groups on the matching variables, which were the final examination grade for the Chemistry 1 and the average of the three hour-examinations in Chemistry 1 (the first semester part of the course which all of the students had taken during the preceding semester).

The variances and multiple correlations for the three experimental groups were also compared. In all these analyses, the data from the three receiving rooms were combined for comparison with the data from the television originating classes and the standard lecture room classes.

The results of these analyses are summarized in Table 1 in the next section of the report.

7-3-4-2 General Psychology. The reliabilities of the four examinations given in this course were estimated by analyzing the variance of the item scores for each of the examinations. Such an analysis separates the variance of the item responses into three parts: that due to differences between people, that due to differences between item difficulty, and that which is error variance. This estimate is much more accurate than the one used for the chemistry tests and makes no assumptions about the item difficulties and item intercorrelations. As was true for the chemistry tests, this is an estimate of the correlation between each of these tests and a second hypothetical test of the same content. It is *not* an estimate of the correlation between the scores on this test given on two occasions.

The means of the experimental groups in General Psychology were compared by doing an analysis of covariance of each of the test scores. In this case, the matching variables were two of the subtests of the *Pennsylvania State College Readiness Aptitude Examination: Vocabulary and Paragraph Reading*. Thus the means were adjusted for differences between the means of the groups on these two tests taken prior to the beginning of the experiment.

In this course the data were analyzed so that differences between instructors could be compared as well as the interaction between the instructor and the mode of lecture transmission. The data from all the classes which saw and heard the lectures on the television sets were combined for comparison with the other two groups (those in the originating room and those in the standard classroom situation). The variances and multiple correlations were also compared for the three groups. The results are given in Table 2.

7-3-4-3 Psychology of Marriage. The reliabilities of the three tests given in this course were also estimated by analyzing the variance of the item scores.

The date for the three receiving room groups in this course were combined for comparison with the data for the group taught by the instructor in the television originating room. The comparison of the means of these two groups was made by analyzing the variance of the total test scores. The variances of the two groups were also compared. There were no matching variables for use in an analysis of covariance. Results are presented in Table 3.

7-3-5 Limitations of the Information Tests

The information tests used to evaluate the effects of the different modes of presentation in this project were constructed by the course instructors and were essentially the same kinds of tests that would have been used if these courses had been taught without television. Consequently the measuring instruments had certain limitations for use in evaluating the effects of the television presentation. The effects of these limitations probably reduced the possibility that differences between the relative effectiveness of the different methods would be significant.

The principal limitation which occurred particularly in General Psychology was the result of the fact that the instructors in psychology are in general unwilling to have their students tested by examinations constructed by people other than the instructors themselves. Thus any material that the instructors thought was not adequately presented by all of the methods used was not tested. This was not a problem in chemistry where it is customary to use departmental examinations.

A second limitation, particularly in psychology, was that the only material tested was that which both instructors agreed that they had covered in their lecture discussions, or which was in the textbook, and therefore was available to all sections of the course. Thus, the possibility of finding differences between instructors was reduced, since only material taught by both was tested as agreed; also possible interaction between instructor and method was reduced in the measurements.

A third possible limitation in the measurement of information arises from the fact that most instructors integrate the use of the textbook into the course, so that it is difficult to know whether information was learned in class or from the textbook or from both. This meant that a majority of the test questions could have been answered by a close study of the textbook alone (this was most true for General Psychology). Furthermore, although lecture discussions or demonstrations may be designed to clarify or emphasize facts and principles presented in the text, most classroom examinations measure factual information, while understanding of principles and ability to generalize from facts are seldom measured adequately.

Finally, it would have been desirable to include some pictorial test questions which would have tested the contributions of the visual materials which accompanied the lecture. This was particularly true for the chemistry course.

7-4 MEASURE OF ATTITUDES

In addition to measures of achievement, it was desirable to obtain measures bearing upon the students' opinions and judgments concerning instruction by television and their attitudes toward the courses and their content as these might be influenced by conditions under which the course was presented. Most of the attitude measures used were devised by members of the staff for this project; others were extant standardized tests.

The measures were aimed at quantitative assessments of the results of experience and instruction in terms of student reactions. Items for scales were not, therefore, drawn directly from course content or materials.

It is generally conceded that measures are difficult to make of persisting changes in attitudes, modifications in strengths and kinds of interests, and changes in personal goals and objectives. At the same time these are probably among the most important results of education.

7-4-1 Students Reaction Schedules

A form was administered to students in the television receiving room *groups only* on which they were asked to rate (separately) their estimated amount of learning and interest in the course relative to what these probably would have been were they taking the course in the conventional face-to-face class situation. They could check: much more, a little more, about the same, a little less, or much less. They were then asked to write a paragraph explaining the reasons for their ratings. In addition to estimating their probable interest and learning, and writing their reasons for their choices, the students were also asked specifically in the second part of the form to write on the advantages and disadvantages of learning by television and to suggest improvements in the course and/or mode of transmission and viewing conditions.[1] In general, it was found that these comments duplicated, paralleled or grew logically out of the reasons they had given for their estimated learning and interest.

This questionnaire was administered to students in General Psychology and Psychology of Marriage after the fourth and thirteenth weeks and after the final examination. Students in General Chemistry were given the form (first part only) after the eighth week and after the final examination. The students in the psychology courses completed the forms anonymously but those in chemistry signed their names.

The task probably was somewhat more realistic for the chemistry students than for those in psychology since those in chemistry had taken the first semester of that course in the conventional lecture situation and therefore had a better basis for comparison than those in psychology. Psychology students had to compare television instruction with other similar courses or with how they imagined it would affect them. Nevertheless, the measure is useful as an estimate of student opinion and as an indication of change of opinion with increased experience with learning by television. (This was the only attitude measure used in relation to General Chemistry.)

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[1] See Appendix 8.

7-4-2 Rating of Psychology with Other Courses

During the last week of classes all students in the General Psychology class were asked to fill in a questionnaire purportedly distributed by a "Curriculum Survey Committee." They were asked to rank all of the courses they were taking that semester in the order in which (1) they were contributing to their academic objectives and (2) they were liked by them.

It was hoped that differences between the experimental groups in the rank they gave to General Psychology could be attributed to the manner in which they took the course, i.e., face-to-face or via television.

7-4-3 Personal Relevance of Course and Information

A Guttman-type scale of personal relevance of the content of a course had been developed on the Instructional Film Research Program and was used in this study. This scale was developed to measure the perceived immediacy or remoteness of the use of information learned by students and the effects of these perceptual judgments on learning. The items of this scale appeared to be appropriate for measuring students' judgments of the usefulness of a course as they perceived it.[1]

7-4-4 Attitudes toward Psychology and Psychologists

It was assumed that a course in General Psychology should influence students' attitudes and opinions of psychology and psychologists. Hence, during the final week of class, all students in General Psychology were asked to complete a Guttman-type scale of attitudes toward psychology and psychologists.

7-4-5 The F Scale

The F Scale was developed by Adorno *et al.*[2] They believe it to be a measure of "authoritarianism" or the "authoritarian personality." Many of the items in the scale elicit reactions on a wide range of topics discussed in General Psychology, such as prejudice, recognition of individual differences, child rearing, the treatment of individuals who deviate from accepted social norms and similar subjects. It was believed that an introductory course in psychology would influence attitudes as measured by this scale; specifically, would reduce "authoritarianism" as defined and measured by the test.

Consequently, the scale was administered to all General Psychology students during the first and last weeks of class, the assumption being that if some groups changed more than others this change might be attributable to the use of television, all other factors being constant.

7-4-6 Election of a Future Course

One possible measure of the effectiveness of an introductory college course is the number of students who elect to take additional courses in the area. In order to get an immediate approximation of the number who would be interested in future courses, and to limit and standardize choices which the students would have, the following procedure was employed: An article was printed in the University daily student newspaper stating that, if the demand justified it, a new course in General Psychology would be given during next Fall Semester which would be an extension of the course they were taking. The subject matter would be similar but a knowledge of the introductory course material would be assumed and the subject matter would be given in greater depth and scope. The article went on to explain that students presently taking General Psychology would have first priority in enrolling for the course and that, shortly, they would be given the opportunity to indicate whether or not they would like to take such a course. With this orientation, the announcement was repeated in the psychology class and each student was given a card on which he was to sign his name and write "yes" or "no." Students were told that this did not constitute an official registration or commitment but insured a place in the class, if the course were given, for those who indicated that they wished to take the course.

A follow-up study was made immediately prior to the final examination. An announcement was made that the number requesting the course had been so large that the course would have to be given either in a single *large section* of about 200 or by television in multiple-sections of approximately 30 students. Those students who originally exhibited an interest in the course now, therefore, had three choices: (1) take it in a large section, (2) take it by television, (3) not take it at all under either of these two situations.

It will be noted that an attempt was being made in part to get indications of student preferences between large lecture sections versus classes of about 30 students taught over instructional television.

7-4-7 The Marriage Happiness Prediction Inventory

This instrument, designed and validated for predicting marital happiness, was administered at the beginning and end of the course on the Psychology of Marriage as an attempt to measure overall effects of the course.

7-4-8 Evaluation of Adequacies and Inadequacies of Attitude Measures Used

Results of paper-pencil measures of attitude must be accepted with caution. What a person reports on a check list or scale may, but need not, correspond to the way he will act or to what he really believes. Certainly a student may respond on such abstract tests in ways which do not truly represent his probable actions. Some students, supposing that they know what response the instructor or test administrator wants, may respond accordingly in order to avoid possible disapproval; or others, to show their independence may react in an opposite direction and thus give invalid responses.

Every reasonable effort was made in this experiment to obtain honest responses. Students were *assured* and *reassured* that their responses would not even be known to their instructors. Whenever practicable, the tests were anonymous and some measures were divorced from the courses or the presumed interest of the instructor. For example, students in General Psychology normally have to participate in research studies quite divorced from the course. Some of these measures were represented as being such studies. The Election of a Future Course could be presumed to be related to the department administration and planning relative to student interests and not the experiment.

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[1] Scale is given in Appendix 7.
[2] The F Scale is given in Appendix 6.

The sensitivity of the measures must also be taken into account in making inferences. Little information is available to indicate how much difference in the attitudes of the student, resulting from the different instructional treatments, is necessary in order to produce measurable differences or changes in behavior. This relates of course to the problem of interpreting non-significant differences. A non-significant difference as *measured* may mean that the different treatments did not affect the attitude measured; but a non-significant difference may also occur in the presence of important differences which the measures were not sufficiently sensitive to detect and represent. A difference of a very small portion of an inch in the diameter of a cylinder, for example, would have marked effects on the performance of an engine, but the difference could not be detected by using a yard stick as the measuring device.

7-5 QUALITATIVE OBSERVATIONS AND RECORDS ON REACTIONS

Although they lack the rigor and control of the tests and scales administered to the students, and are subject to personal bias, it was thought, nevertheless, that systematic and accurate observations of those associated with the project would be valuable. Consequently, all persons continuously associated with the courses and experimental groups kept a record of their observations.

7-5-1 Logs of Instructors and Observers

Instructors kept notes on their reactions to teaching over television and prepared summary evaluations at the end of the semester. These are given in Section 8.

The receiving room observers also kept records of student reactions to instructional television and prepared statements of their own reactions at the end of the semester.[1]

7-5-2 Reports of Operators

Equipment operators kept a log reflecting the condition of the equipment on each day, its inadequacies and steps taken to correct or eliminate them.

Engineering assistants developed a standard form late in the semester for recording detailed and specific information on equipment failures or defects, what was done to correct these, and recommendations for the future.

7-5-3 Informal Interviews with Students

From time to time opportunities occurred for informal interviews with students, especially those in the television sections. A group of about twelve students (some from chemistry and some from the psychology classes) were invited to meet with representatives of the sponsoring Fund in order that these officers could hear some first-hand and frank opinions about instruction via closed-circuit television.

It was expected that a substantial number of students might wish to transfer from the television receiving rooms to the face-to-face rooms or to drop the course because of television. Actually very few such cases occurred. In the cases where students thought they might want to change they were interviewed so as to ascertain their reasons and points of view.

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[1] The observers' record form is given in Appendix 9.

8—Results Relative to Main Objectives of the Project

It is probably worthwhile at this time to review the main objectives of the study in order to assess the results relative to them.

The principal purpose of this project was to study the effectiveness of unmodified or conventional courses when taught for a full semester over closed-circuit television using "moderate" cost equipment, as compared with the same instruction given in the usual manner. It was agreed, furthermore, that information would be collected on the acceptability of televised instruction to administrative officers, to faculty members and to students.

8-1 RESULTS ON INFORMATION TESTS AND EXAMINATIONS

Measurements of academic achievements or the learning of course materials by students typically emphasize measurements and assessments of the amounts of information or facts and principles which students learn relative to distribution of test or examination scores for classes, and relative to more or less defined "standards."

It was realized from the beginning of the Television Project that measures of factual information would be the most dependable measures of the relative effectiveness of television-taught and conventionally-taught classes of students. The results of the measures used will be given below.

8-1-1 General Chemistry—Information Tests

The results of the analysis of the data obtained in the chemistry course are presented in Table 1. A summary and interpretation of the analysis is presented in a following section.

Table 1 shows that the differences between the means of the three groups on all of the examinations could be due to random differences between the groups prior to the beginning of the experiment and are not, therefore, due to the modes of presentation. The same is true for the differences between the standard deviations and the correlations of the Chemistry 1 measures with the Chemistry 2 measures for the three groups.

Although the rank order of the means of the three groups is in general the same for all four tests, it should be remembered that the analysis of the results for the four tests is based on essentially the same people so that any random differences in the groups prior to the beginning of the experiment will affect all the test scores in the same way. In other words, the analyses of the four

TABLE 1

SUMMARY OF RESULTS ON INFORMATION TESTS FOR GENERAL CHEMISTRY

Exam		*Standard Lecture Room*	*TV Receiving Classroom*	*TV Originating Lecture Room*	*F-Ratio*	*Multiple Correlations*[1]	*Reliability*[2]
1	Mean	73.71	71.39	73.41	$F_{2,371} = 1.52$	.75	.91
	Adj. Mean	72.25	72.30	74.62			
	Std. Dev.	17.97	18.89	17.71			
	No. of Students	158	105	112			
2	Mean	81.41	78.54	79.60	$F_{2,360} < 1$	.71	.80
	Adj. Mean	80.39	79.29	80.36			
	Std. Dev.	19.01	20.60	16.74			
	No. of Students	155	102	108			
3	Mean	73.46	72.83	71.83	$F_{2,349} < 1$	.69	.92
	Adj. Mean	72.54	73.21	72.79			
	Std. Dev.	19.48	18.88	17.08			
	No. of Students	151	96	107			
Final	Mean	67.92	66.38	66.49	$F_{2,338} < 1$	.71	.89
	Adj. Mean	67.28	66.67	67.14			
	Std. Dev.	15.13	13.90	12.98			
	No. of Students	147	93	103			

[1] This is the correlation of scores on the Chemistry 2 tests with scores on the Chemistry 1 one-hour tests and final examination.

[2] The reliabilities were estimated by Kuder-Richardson Formula 21.

TABLE 2

Summary of Results on Information Tests for General Psychology

Exam		*Standard Lecture Room*	*TV Receiving Classroom*	*TV Originating Lecture Room*	*F-Ratio*[3]	*Correlations*[1]	*Reliability*[2]
1	Mean	48.15	47.16	46.97	$F_{2,312} = 1.10$	.54	.77
	Adj. Mean	48.08	46.98	47.42			
	Std. Dev.	7.74	7.14	6.56	$F_{1,312} < 1$		
	No. of Students	79	161	78			
2	Mean	50.00	48.28	47.55	$F_{2,297} = 4.01$*	.53	.83
	Adj. Mean	49.99	48.09	47.94			
	Std. Dev.	6.11	6.23	6.30	$F_{1,297} = 1.10$		
	No. of Students	75	155	75			
3	Mean	49.01	47.95	48.00	$F_{2,293} < 1$	.40	.83
	Adj. Mean	48.87	47.84	48.35			
	Std. Dev.	7.88	7.76	6.51	$F_{1,293} < 1$		
	No. of Students	74	152	75			
Final	Mean	85.23	82.78	83.31	$F_{2,293} = 1.57$	.53	.87
	Adj. Mean	85.00	82.53	84.05			
	Std. Dev.	11.50	12.62	11.48	$F_{1,293} = 4.17$*		
	No. of Students	74	152	75			

[1] This is the correlation between the scores on the Psychology examinations and the Vocabulary and Reading sections of the *Pennsylvania State College Academic Aptitude Examination.*

[2] This reliability was estimated by an analysis of variance.

[3] The subscripts on F indicate the degrees of freedom. The first F in each case is for the comparison between the means of the experimental groups; the second is for the comparison between the means of the two instructors. In no case was the interaction between instructor and mode of presentation "significant."

* This difference is significant at the .05 level.

tests are not independent from the point of view of the sampling of students.

The tests and examinations in General Chemistry were verbal tests. They did not include visual-pictorial tests of materials thus learned. This problem is under study.

The use of the matching variable in the analysis of the data made no real difference in the conclusions drawn from these data.

8-1-2 General Psychology

The results of the analysis of the data for the General Psychology course are summarized in Table 2.

The differences between the means, variances and correlation coefficients of the three groups on all of the tests, except the second, could be due to random differences between the groups prior to the experiment and were not the result of the modes of presentation.

On the second test in this course the mean of the group taught in the standard lecture room, i.e., the main control group, was significantly higher than the mean of the group taught in the television originating room at the two per cent level of significance; it was significantly higher than the mean of the classes taught in the television receiving rooms at the one per cent level of significance. This means that the probability that these differences were due to random differences between the groups prior to the experiment is about .02. Small but insignificant differences favored the main control groups compared with television-taught classes on all tests and the final examination.

Although the difference on the second test was the only significant difference found, it should not be dismissed as a peculiarity due to sampling, since essentially the same people took all the examinations, and the comparisons of the means on the four different examinations are not independent. In view of the non-significant differences on all other tests and examinations, this significant difference is unusual, but is probably a result of something much more complex than simply the difference between the instructional presentations.

This difference is also unusual in view of the nature of the examinations used. As mentioned above, most if not all, of the questions could probably have been answered by careful reading of the textbook used in all the sections of the experiment. Since this difference did occur under these circumstances, it would suggest the possibility that some unknown factor important to learning of information was operating in this section of the course.

There was a small but significant difference on the final examination between instructors even though the same textbook and modes of presentation of instruction were used. No tests showed that the *interactions* between the *instructors and the mode of presentation,* television or no

TABLE 3

SUMMARY OF RESULTS ON INFORMATION TESTS IN THE PSYCHOLOGY OF MARRIAGE

Exam		*TV Originating Lecture Room*	*TV Receiving Classroom*	*F-Ratio*	*Reliability*[1]
1	Mean	102.00	105.39	$F_{1,137} = 1.90$	.73
	Std. Dev.	13.91	12.37		
	No. of Students	38	101		
2	Mean	98.87	101.14	$F_{1,135} < 1$	.73
	Std. Dev.	13.15	13.13		
	No. of Students	38	99		
3	Mean	79.68	80.18	$F_{1,132} < 1$	.62
	Std. Dev.	8.09	10.59		
	No. of Students	37	97		

[1] This reliability was estimated by an analysis of variance. The mean scores were not adjusted.

(A mimeographed supplement containing complete tables for the analyses of variance and for the tests of homogeneity of variance and regression for all three courses is available and may be obtained upon request.)

television, have an influence on information learning in psychology *as measured* in this experiment. The use of the matching variable made no real difference in the conclusion which could be drawn from the data.

8-1-3 Psychology of Marriage

The results of the analysis of the data for the course in the Psychology of Marriage are presented in Table 3.

The results presented in Table 3 indicate that the difference between the means could have been due to differences between the groups at the beginning of the experiment. The same is true for the differences between the standard deviations of the groups.

The reliabilities of the examinations used in this course are rather low, due probably to the fact that the tests covered so many small details on which many of the students had to guess. Many of the questions required the kinds of information students would learn only if they were studying for this specific kind of test. The instructor in this course attempted to write test items on content which was given in his lectures and *not* given in the textbook. This may have influenced the results in that there was more opportunity for differences between the modes of presentation to be revealed by the tests and there was less "contamination" of the instruction.

8-1-4 Interpretations of Results on Informational Learning Tests

What interpretations can be made of these results?

The main purpose of the experiment was to determine whether students learned *less, an equal amount or more* (i.e., the relative effectiveness) when taught over television for a full semester when compared with the same instruction (content and method) presented directly by instructors to students.

Several theoretical considerations given in the earlier parts of this report, especially in sections on the functional characteristics of television related to communications theory, could be the basis for the following related assumptions:

1. That when instruction is channeled through a television system the effectiveness will be somewhat reduced compared with direct presentation.
2. That conversely, when instruction is channeled through a television system it is very improbable that the effectiveness will be increased compared with direct presentation of the same instruction.

These assumptions would lead to the expectations that instruction given over television would most probably be of *less* or *equal* effectiveness rather than be more effective than regular instruction.

These assumptions are based on propositions that the main determinants of teaching-learning effectiveness are functions of (a) the teacher and his competencies, (b) the subject taught and methods of teaching, (c) the student and his abilities and motivation, and (d) the interactions of these factors. The *channels* and *mode* of presentation are, therefore, of secondary importance as determinants of learning.

These broad generalizations, like all such generalizations, probably have exceptions and these need to be explored.

Now then, the main problem under investigation can be redefined: When conventional instruction is channeled over a television system and presented by television receivers for a full semester and is compared with similar direct instruction, do students learn an *equal* amount or *less* information as measured by above average tests?

The answers for these two possibilities are:

1. The differences as measured were not *statistically* significant (except one test for General Psychology).
2. Nevertheless, it cannot be concluded that the modes of presentation were in fact equally effective.

The problem becomes that of how to interpret *statistically non-significant differences.* What does this result mean, or what are some possible explanations?

First, it may be speculated that there were in reality differences in learning between the television-instructed and directly-instructed students which were not measurable by the tests and examinations which were used. The measured samples of total learning may have lacked the required sensitivity or appropriateness to *detect* and *reflect* the full differences. It should be remembered, however, that the tests used had fair to good reliabilities and were probably superior to most tests used in universities as bases for determining the academic fate of thousands of students annually. Efforts can be made to improve measurements of information.

Secondly, sources of information and stimulation for learning available to students, other than those presented to them over television, or in the face-to-face classes, may have reduced the probabilities of getting measurable differences. Such sources were the textbooks, library resources, and informal student discussions for all the courses, and in addition, the recitation sessions and laboratory exercises for General Chemistry. After all, extensive patterns of study and learning are involved in university coursework, and only parts of these were controlled by the experiment. A rigid experimental design would require that *all* relevant teaching-learning processes be controlled and hence channeled through television.

Third, it may be argued that differences were not revealed because tests measured relatively *recent* learning and that delayed or retention measures might show differences. This explanation is improbable. Retention of learning curves (memory) show losses rather than gains and differences are likely to become smaller with passage of time rather than larger. However, this possibility will be studied.

Fourth, it may be thought that students of the television classes *assumed more responsibility* for their own learning and hence *compensated* for any disadvantages which televised instruction might have had for them. This intriguing possibility will be investigated.

Finally, especially for the lecture demonstrations in chemistry, the tests were in abstract verbal form. The possibility exists that learning instigated by visual, pictorial representations was not measured by these tests.

The *consistency* and *trends* of the small differences between groups should be examined.

The experiment involved two full-semester sequences of General Psychology taught by two different instructors using the lecture discussion method. A course of a somewhat clinical content in the Psychology of Marriage was taught by one instructor using the lecture method, likewise for a full semester. The basic lecture demonstration part of General Chemistry was taught by three instructors for an entire semester. The number of students, their assignments to comparison groups and the tests were at least adequate for most purposes.

Table 4 shows the small differences in adjusted means between comparison groups.

For General Chemistry, as can be seen, there was considerable shifting of small advantages between comparison groups.

TABLE 4

DIFFERENCES BETWEEN ADJUSTED MEAN SCORES FOR SEVERAL COMPARISONS[1]

		Comparison 1		*Comparison 2*		*Comparison 3*	
Course	*Test*	*Standard Classes* *vs.*	*TV Receiving Classes*	*Standard Classes* *vs.*	*TV Originating Classes*	*TV Receiving Classes* *vs.*	*TV Originating Classes*
General Chemistry	1		.05		2.35		2.32
	2	1.10			.03		1.07
	3		.67		.25	.42	
	Final Exam	.61		.14			.47
General Psychology	1	1.10		.66			.44
	2	1.90*		2.05*		.15	
	3	1.08		.52			.51
	Final Exam	2.47		.95			1.52
Psychology of Marriage	1	No Standard Control class; therefore, no comparison possible		No comparison possible		3.39	
	2					2.27	
	3					.50	

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[1] Difference figures are listed under the classes with the higher mean score.

* Indicates that the difference was significant at the 5 per cent level or better.

For General Psychology the small differences between standard classes and television receiving classes and standard classes and television originating classes all favored the standard or conventionally taught classes. Three differences favored the television originating classes and one the television receiving classes in the comparison of these two groups.

For Psychology of Marriage all differences on three tests favored the television receiving classes over the classes taught in a large lecture room where the instruction was televised.

It should be noted that only two of all the above mentioned differences reached accepted levels of statistical significance.

8-1-4-1 Trends Over the Semester. One of the main objectives of this project was to determine the results of regular sustained instruction via television over an entire semester. "Novelty," "Hawthorne" and monotony-fatigue effects have been postulated.

What is the evidence from this study on changes over the semester?

Comparable tests were not used. All differences, as has been seen, were small and mostly statistically insignificant. A study of trends of test score differences does not show any consistent trends. If significant trends existed, as far as was learned, they were in the areas of attitudes and opinions and were not shown in achievement test scores.

8-1-5 General Conclusion

What do these results mean in a broad perspective? What do they mean in the context of current and impending problems for higher education?

It is logical to conclude that there is no basis in the evidence found on information learning for rejecting the use of instructional television for teaching courses and students like those used in this experiment. The degree to which this conclusion can be generalized to courses, methods and student populations other than those sampled in this project still remains to be determined.

The evidence available indicates that decisions to use or not to use instructional television in such courses as were studied in this experiment and for defined student populations must be made on the basis of administrative policies, acceptability of televised instruction to students and faculty and other practical considerations. Such decisions cannot be made only on the basis of difference scores in the amount of informational learning by students taught directly by several conventional methods compared with televised instruction.

8-2 MEASURES OF ATTITUDES AS INDICATORS OF STUDENT ACCEPTANCE OF TELEVISED INSTRUCTION

It is possible that even though no differences of significance were found in learning, nevertheless student attitudes and opinions may weigh for or against the use of instructional television. Admittedly, attitudes and opinions are difficult to measure and especially to validate. However, serious attempts were made to sample student attitudes and opinions systematically as one means of collecting evidence on the acceptability of this mode of instruction to students who actually were instructed over television.

The measuring instruments used have been described previously.

8-2-1 Student Reaction Schedules

Students in the television receiving rooms in each of the courses estimated their probable *learning* and *interest* (as compared to conventional instruction) at different times during the courses.

The percentage of students selecting each alternative on a scale of probable learning is given in Table 5.

TABLE 5

STUDENT ESTIMATES OF PROBABLE LEARNING BY TELEVISION AS COMPARED TO CONVENTIONAL INSTRUCTION [1]

	General Psychology			*Psychology of Marriage*			*General Chemistry*	
	4th week (N = 134) Per Cent	*13th week (N = 142) Per Cent*	*Final (N = 143) Per Cent*	*4th week (N = 93) Per Cent*	*13th week (N = 89) Per Cent*	*Final (N = 86) Per Cent*	*8th week (N = 103) Per Cent*	*Final (N = 101) Per Cent*
Much More	2	1	3	2	0	0	1	2
A Little More	12	11	11	16	13	24	20	16
About the Same ...	36	38	43	57	65	56	40	37
A Little Less	44	39	31	23	20	15	34	38
Much Less	6	9	11	1	1	5	5	7

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[1] A *"favorable attitude"* toward televised instruction could logically be considered to include those checking "About the Same," "A Little More" and "Much More." When this is done, the students can be said to be predominantly "favorable" in their attitudes toward televised instruction. The problem of *acceptability* is a very different one. Students accept many educational practices, e.g., term papers, examinations, required class attendance, towards which they may not have "favorable attitudes."

TABLE 6

STUDENT ESTIMATES OF INTEREST OF COURSES BY TELEVISION
RELATING TO CONVENTIONAL INSTRUCTION [1]

	General Psychology			*Psychology of Marriage*			*General Chemistry*	
	4th week	*13th week*	*Final*	*4th week*	*13th week*	*Final*	*8th week*	*Final*
	(N = 137)	*(N = 142)*	*(N = 143)*	*(N = 93)*	*(N = 89)*	*(N = 86)*	*(N = 107).*	*(N = 100)*
	Per Cent	*Per Cent*	*Per Cent*	*Per Cent*	*Per Cent*	*Per Cent*	*Per Cent*	*Per Cent*
Much More	8	4	6	5	1	5	6	5
A Little More	32	26	20	18	19	26	18	23
About the Same ...	28	30	22	52	48	29	29	24
A Little Less	23	31	34	23	28	30	38	27
Much Less	8	9	17	1	3	10	10	22

[1] A "*favorable attitude*" toward televised instruction could logically be considered to include those checking "About the Same," "A Little More" and "Much More." When this is done, the students can be said to be predominantly "favorable" in their attitudes toward televised instruction. The problem of *acceptability* is a very different one. Students accept many educational practices, e.g., term papers, examinations, required class attendance, towards which they may not have "favorable attitudes."

No clear trends are evident in these data although the bulk of students indicated they thought they were learning "about the same" or a "little less" by television. Comparing final ratings it will be seen that the highest ratings were given by the students in the Psychology of Marriage course; the lowest by those in General Chemistry. It will be recalled that the students in General Chemistry had had the first semester of lecture demonstrations of this course in the conventional, large class situation and therefore probably had a reasonable basis for making the rating. Almost half of the students in chemistry believed that they were learning somewhat less by television.

Comparing responses by individuals in the same class at different times, it would appear that opinion has remained fairly constant. Such changes as occurred are not consistent from class to class and must be assumed to be chance fluctuation. Thus, there were no important trend differences over the semester.

Nor did there appear to be a consistent trend with respect to rating of the *interest* of the course relative to conventional instruction. The data are given in Table 6.

It must be remembered that, because of the nature of the measures, no comparable measure of the students *not* in television sections could be made. Therefore it is not known to what extent course content or the instructors influenced the ratings.

8-2-1-1 Representative Comments Written by Students. For those students who felt that they were *learning more by television* than they would in a conventionally taught class, their reasons broke down into three principal categories:

1. See and/or hear better: It is interesting to note that "hear better" was a more common response than "see better." Also, persons responding in this category frequently would add that their name placed them in the latter part of an alphabetical listing so that they usually were seated in the back of a room. Hence, for them, television brought the instructor closer.

2. Fewer distractions: The television screen constitutes a center of attention free of the extraneous distractions common in a classroom.

3. Professors better prepared: Students *thought* that instructors prepared their materials better and credited television for the improvement. Related comments had to do with making it possible for students to take courses from the best instructors.

4. Novelty: Some students felt that the experience was new and different and therefore made the class more interesting.

5. Additional advantages attributed by students to television included uniformity of instructors and grading and decreased costs for instruction although students did not necessarily feel that these were beneficial to them.

Among reasons given by students who felt that they were *learning less* by television were these:

1. Lack of interaction between instructors and students, and among students particularly in psychology:

Psychology students complained that they could not conveniently ask questions or discuss topics of interest to them, that their professors were remote and they, the students, mere "numbers on a seating chart."

This lack of interaction was the most frequently expressed comment, positive or negative, which psychology students made about television. It should be noted that chemistry students could ask questions in their laboratory or recitation sections.

2. Boredom: The "absence of distraction" which some students called a virtue others nominated as a vice, saying that the limited center of attention, the television screen, induced boredom and sleep. Their inability to participate in class discussion was also thought to foster boredom.

3. Lack of color: In chemistry, particularly, lack of color was thought to be a disadvantage by some students.

4. Many students believed that the cameraman or camera controller determined to what they must attend and for how long. They did not think that this was desirable. This was by far the most common complaint in chemistry where there was much blackboard work. Students in the receiving rooms complained that after the instructor started on a new topic and the cameras followed him, they could not take notes on previous material still on the blackboard.

It should be recognized that while the categories of negative and positive comments are about equal, the frequency of comment within those categories tended to be negative, as did the intensity of the comments. That is, a few students reacted with comments such as "This is the worst thing that could happen to education" or "This is a crime," but there were no correspondingly strong favorable reactions.

Reactions of the intermediate groups: It should be pointed out also that between those who took a positive or negative position there was a large group comprised of those who indicated that it didn't seem to make much difference how the material was presented.

8-2-2 Rating of Psychology with Other Courses

The results on this measure are summarized in Tables 7 and 8.

It will be seen in the tables that the students taking the course with the instructor in the same room ranked psychology significantly higher among their courses than did students in the television receiving rooms. The difference was found both with respect to liking for the course and the estimated contribution of the course to educational objectives. No differences were found between groups in the originating classes and those in the standard classes.

TABLE 7

RANKING OF PSYCHOLOGY WITH RESPECT TO OTHER COURSES IN RESPONSE TO QUESTION "HOW MUCH HAS EACH OF YOUR COURSES CONTRIBUTED TO YOUR EDUCATIONAL ADVANCEMENT?"

Room		*Rank*[1] *1-2*	*3*	*4-8*	*Total*
TV Originating Classes	Frequency	32	13	21	66
	Per cent	48%	20%	32%	100%
TV Receiving Classes	Frequency	48	44	47	139
	Per cent	35%	32%	33%	100%
Standard Classes	Frequency	34	13	15	62
	Per cent	55%	21%	24%	100%

$\chi^2 = 9.41$ d.o.f. = 4 $.10 > p > .05$

[1] A rank of 1 indicates that General Psychology contributed the most to educational advancement.

When the frequencies for the television originating room and standard lecture room are combined and compared with those for the television viewing rooms, chi square equals 8.49, which for two degrees of freedom has a value for p between .02 and .01.

TABLE 8

RANKING OF PSYCHOLOGY WITH RESPECT TO OTHER COURSES IN RESPONSE TO THE QUESTION "HOW MUCH DO YOU LIKE EACH OF YOUR COURSES?"

Room		*Rank*[1] *1-2*	*3*	*4-8*	*Total*
TV Originating Classes	Frequency	28	20	19	67
	Per cent	42%	30%	28%	100%
TV Receiving Classes	Frequency	43	34	61	138
	Per cent	31%	25%	44%	100%
Standard Classes	Frequency	31	12	18	61
	Per cent	51%	20%	29%	100%

$\chi^2 = 10.84$ d.o.f. = 4 $.05 > p > .02$

[1] A rank of 1 indicates that General Psychology was the course most liked by the students.

When the frequencies for the television originating classes and the standard lecture classes are combined and compared with those for the television receiving classes, chi-square equals 8.08, which for two degrees of freedom has a value for p between .02 and .01.

8-2-3 Personal Relevance Scale

The scale used to measure the personal relevance to the students of the information presented in General Psychology was an adaptation of one constructed for a study using several instructional films. In this earlier Instructional Film Research Program study, McNiven constructed a Guttman-type scale, using the criteria for item selection set forth by Guttman. Therefore, it seemed necessary to check the scalability of the items and the effect of combinations of item categories prior to using it in the present study. Because the scale was not available until shortly before it was needed for this study, it was necessary to combine categories and check the scalability using students taking part in this study. (See appendix for scale items.)

The six sections of General Psychology were divided in two halves at random. One of the halves was used for checking scalability and for making combinations of item categories. Although there were six categories of response for each question, these were combined into either two or three categories for scaling purposes. The scale is given in the appendix. The second half was used for a comparison of the various groups with respect to means and standard deviations.

TABLE 9

SUMMARY OF ITEM INFORMATION FOR THE SCALE OF PERSONAL RELEVANCE

Items	*1*		*2*		*3*			*4*			*5*	
Categories[1]	*3*	*1*	*3*	*1*	*3*	*2*	*1*	*3*	*2*	*1*	*3*	*1*
Frequency and Per Cent of Response in Each Category	145 95%	8 5%	147 96%	6 4%	8 5%	79 52%	66 43%	6 4%	129 84%	18 12%	86 56%	67 44%
Error in Each Category	1	1	0	2	1	14	12	0	10	5	13	0

Items	*6*		*7*		*8*		*9*		*10*		
Categories[1]	*3*	*1*	*3*	*1*	*3*	*1*	*3*	*1*	*3*	*2*	*1*
Frequency and Per Cent of Response in Each Category	132 86%	21 14%	116 76%	37 24%	124 81%	29 19%	121 79%	32 21%	4 3%	134 88%	15 10%
Error in Each Category	2	5	7	14	7	5	5	6	3	2	3

[1] The higher numbered categories are the more favorable towards the usefulness of the General Psychology course. Coefficient of reproducibility equals .92.

The marginal frequencies for errors after combinations were made for each of the ten items and the coefficient of reproducibility are presented in Table 9. The combinations were made on the basis of data for the first half of the sample. The figures in Table 10 are for the second half, used for comparing the groups.

The results in Table 9 indicate that this scale was fairly satisfactory for discriminating people in the second half of the sample. There is a wide range of marginal frequencies (from 56-44 to 96-4) with only two items having very extreme marginals (items 1 and 2). The ten items include three trichotomies which contribute to the discriminatory power of the scale.

All the items had more favorable responses than unfavorable responses which indicates the high degree of favorableness of the subjects in relation to the perceived usefulness and relevance of the course in General Psychology. The coefficient of reproducibility, which is .92 for this sample, indicates the accuracy with which a subject's item responses could be predicted from his total score. If perfect prediction could be made, the cofficient of reproducibility would be 1.00, while .90 has arbitrarily been set as the level necessary for accurate prediction. In the case of this particular sample, the coefficient of reproducibility was probably raised slightly due to the prevalence of favorable responses.

TABLE 10

SUMMARY OF RESULTS OBTAINED FOR THE SCALE OF PERSONAL RELEVANCE IN GENERAL PSYCHOLOGY

		TV Originating Classes	*TV Receiving Classes*	*Standard Classes*	*Total*
Instructor 1	Mean	23.75	24.46	22.67	23.79
	Std. Dev.	4.04	2.85	5.26	3.92
	No. of Students	20	37	21	78
Instructor 2	Mean	23.95	23.13	25.39	23.88
	Std. Dev.	4.56	5.60	2.70	4.79
	No. of Students	19	38	18	75
Total	Mean	23.85	23.79	23.92	
	Std. Dev.	4.19	4.45	4.39	
	No. of Students	39	75	39	

The responses for the first half of the sample did not appear by inspection to be particularly different for the receiving room and face-to-face groups, or for the two instructors, in terms of the amount of error and satisfactory combination of categories.

The means and standard deviations for the second half of the sample are presented by groups in Table 10.

The highest possible score on this scale was 30. An analysis of variance of the data which are summarized in Table 10 indicated that the difference between the various comparisons of means could have been due to random differences prior to the experiment, although the probability that the interaction between the instructors and methods is due to these random differences is about .10.

The interpretation of the results of the analysis of variance is rather tenuous, since the differences between the variances of the sub-groups are significant. The variances between the three methods groups are not significantly different, which suggests that there is an interaction between the instructor and the mode of presentation, in terms of the homogeneity of the students within a group.

It is difficult to suggest any tentative explanations for this interaction, but it seems, in this case, that the effectiveness of a mode of presentation is dependent upon the instructor, since one instructor's classes had the highest scale score mean in the face-to-face situation but the lowest in the receiving situation, while the other instructor's classes showed exactly the opposite reaction.

In order to investigate this problem more completely, it would be desirable to have several other measures of motivational variables similar to that measured by the scale used here. Although the scale appeared to be unidimensional, it would have been desirable to have had items which would have better discriminated between students at the favorable end of the scale, and thus normalized the distribution of responses which, in the case of this scale, was skewed toward the favorable extreme.

8-2-4 Attitude Toward Psychology and Psychologists

The scale used to measure attitude toward psychology was originally constructed as a Guttman scale, and had a high coefficient of reproducibility for the sample on which it was constructed. No check on the scalability was made for this study, since the groups appeared to be so similar that the time and money needed to re-scale it did not seem justified. It appears that the scale probably does not discriminate between people in this sample very well and the differences between the groups are non-significant. The results of the scale are summarized in Table 11.

TABLE 11

SUMMARY OF RESULTS OBTAINED IN THE SCALE OF ATTITUDES TOWARD PSYCHOLOGY

	TV Originating Classes	*TV Receiving Classes*	*Standard Classes*
Mean	33.10	32.74	33.14
Standard Deviation	2.52	2.55	2.78
No. of Students ..	67	139	63

8-2-5 The F Scale

This scale was administered during the first week and again during the last week of class (see appendix). Students were found to be significantly less "authoritarian" as measured by the scale after taking General Psychology. The change between pre- and post-test scores was not significantly different among the experimental and control groups. There was a significant difference between instructors but this may have been due to an error in administration by one of the instructors which made it necessary to administer the post-test scale twice to two of his groups. See Table 12 for a summary of the results.

TABLE 12

SUMMARY OF RESULTS OBTAINED WITH THE F SCALE

		TV Originating Classes	*TV Receiving Classes*	*Standard Classes*	*Total*
Instructor 1	Mean Change	—3.87	—1.23	2.32	—0.86
	Std. Dev. of Change	17.10	16.35	11.74	15.44
	No. of Students	30	74	37	141
Instructor 2	Mean Change	—4.43	—6.73	—3.69	—5.37
	Std. Dev. of Change	20.57	15.53	18.10	17.31
	No. of Students	28	63	35	126
Total	Mean Change	—4.14	—3.76	—0.60	
	Std. Dev. of Change	18.69	16.16	15.36	
	No. of Students	58	137	72	

A minus sign indicates a change in the direction of less authoritarianism.

TABLE 13

NUMBERS OF STUDENTS WHO SIGNED UP FOR "PSYCHOLOGY 200"

		TV Originating Classes	*TV Receiving Classes*	*Standard Classes*	*Total*
Instructor 1	Frequency of Sign Ups	9	11	4	24
	Per Cent of Group Who Signed Up	29%	18%	15%	20%
	No. in Group	31	60	27	118
Instructor 2	Frequency of Sign Ups	12	25	17	54
	Per Cent of Group Who Signed Up	33%	33%	53%	38%
	No. in Group	36	75	32	143
Total	Frequency of Sign Ups	21	36	21	
	Per Cent of Group Who Signed Up	31%	27%	36%	
	No. in Group	67	135	59	

8-2-6 Election of Future Courses

There were no significant differences found among control and experimental groups in the number of individuals signing up for "Psychology 200." However, there was a significant instructor treatment interaction, due largely to the fact that over half of the students in one instructor's group (face-to-face, no television equipment present) indicated an interest in taking the course, whereas only about one third of all other groups indicated an interest in taking the course. See Table 13.

Those students who said they would like to take the course were given the option of (1) taking it in a large class, (2) or taking it in a small class by television, or (3) not taking it under either of these conditions. See Table 14.

TABLE 14

PREFERENCES OF STUDENTS WITH RESPECT TO TAKING "PSYCHOLOGY 200"

Group	*Method*	*N*	*Per Cent*
Standard Classroom	1. Large Class	7	33
	2. Television	8	38
	3. Neither	6	29
TV Originating Room	1. Large Class	7	33
	2. Television	10	48
	3. Neither	4	19
TV Receiving Room	1. Large Class	11	32
	2. Television	18	53
	3. Neither	5	15

Since the numbers are small the percentages are of course quite unstable. However, the percentage who elected to take the course in a large class is consistent from group to group (33%). Of the remaining students in each group the percentage electing to take the course by television increases with increased experience with instruction by television. That is to say, only 38% in the control group would take it by television, 48% in the originating room would take it, and 53% in the television receiving rooms would take another course by television.

8-2-7 The Marriage Happiness Prediction Inventory

This complex and long test which is reported to have a reliability of .87 and a validity of .65 was administered to students in the Psychology of Marriage at the beginning and again at the end of the course.

The pre-course scores averaged 143.95 and the post-course mean was 143.47. The course did not produce changes in the scores of students on this inventory. Furthermore, there were no differences between the students who received instruction over television and those who were in the originating classroom.

8-2-8 Summary Statement of Attitudes of Students Relative to the Acceptance of Instructional Television

What is the general pattern of reactions of students toward being instructed by television?

Students estimated that they were learning about the same or slightly less over television in comparison with face-to-face instruction. Estimates of interest in the course were slightly more favorable to television than the probable learning ratings. Students in General Psychology who were taught over television rated the course, relative to other courses, lower than did those in control sections on estimates of "contribution to your educational advancement." When asked, "How much do you like each of your courses?", the ratings favored conventional instruction. Scores on the "personal relevance" or usefulness scale were somewhat ambiguous although the differences between the three groups appeared to be non-significant.

No differences were found in the students' general attitudes toward psychology as a field of study. The course in General Psychology significantly reduced "authoritarianism," but there were no differences among the control and television experimental classes. When asked to "pre-register" for a proposed continuation course, "Psychology 200," the responses of control and television experimental classes were not significantly different. However, there was a meaningfully higher registration for the main control group (standard classroom) of one of the instructors. These reactions were based on the assumption that the course would be taught conventionally in classes of 35 to 60 students. When asked to choose between television instruction as done this semester and large classes of about 200, television instruction was favored. Furthermore, those who had experience with television instruction favored this mode of presentation more than those who had been taught conventionally. This choice between large lecture classes and televised instruction in small groups is probably a realistic possibility for many students when enrollments increase in universities.

Generally, students were very cooperative or even passive. Much fewer than the average for Penn State "dropped the courses" involved in the television experiment. There were no critical cases or problems which came to the attention of instructors or administrative officers even involving students who failed the course. No objections were heard from the parents of students. There seemed to be general acceptance of the mode of presenting instruction with slightly more negative than positive or enthusiastic reactions.

Most of these indications of attitudes were from General Psychology students. It should be recalled that this was a lecture discussion course in which the conducting of discussions for the television groups was an unsolved problem for this semester. Furthermore, the instructors in this course were somewhat negative toward the television mode of presentation, and little was done to adapt the course and television to each other. These factors were probably reflected in student attitudes and reactions.

General estimates of the attitudes and reactions of students, especially for General Psychology, were clearly and slightly more negative toward instruction by television than toward conventional instruction. In this connection, however, it should be remembered:

(1) That conventional instruction implied, for psychology, classes of 35-60 taught mainly by senior faculty members, i.e., associate professors and professors, and not large lecture sections.

(2) Little or nothing was done to take advantage of the potentials of television or to compensate for its limitations.

(3) Nothing was done during this experiment to increase the acceptability of televised instruction by students.

In conclusion, in this experiment where nothing was done to favor televised instruction, where practical and tried conventional methods were compared with instruction merely projected over television, and where student reactions tended to be slightly negative, nevertheless *this mode of presenting instruction was generally accepted by students.*

8-3 ATTITUDES, REACTIONS AND EVALUATIONS OF INSTRUCTORS AND FACULTY

8-3-1 Summary Statements of Instructors and Television Receiving Room Observers

Most of the sections of this report were written before the summary statements by instructors who taught over television were available for study. Therefore, their opinions, judgments and evaluations represent independent viewpoints. These reactions of instructors are sincere and carefully-considered formulations based on a full semester of experience of teaching or observing essentially unadapted courses over television and with minimum adjustments of television to the courses. Furthermore, the instructors worked within the context of a procedure which, once established, was not varied more than absolutely necessary during the semester.

The evaluations which follow have been made freely and without deference for the positions of administrators or those responsible for conducting the Instructional Television Project. Those who taught for a full semester over television and those who regularly observed students in receiving rooms have experiences based closely in the realities of teaching by television. Therefore, there is here an authenticity of reporting which deserves thorough consideration and analysis.

All those who have taken an active part in the organization of the television project perceive selectively the complex processes and results and make judgments in terms of special interests, problems, values, commitments, objectives and levels of aspiration.

In the interests of scientific objective reporting the statements prepared by instructors and observers are reproduced in full without modification except to make a few terms consistent, e.g., viewing and originating rooms. Thus, some documentary information, including statements of possible problems, is added to the literature on instructional television.

8-3-1-1 Statements by Instructors in General Chemistry

Statement by Grant W. Smith, Professor of Chemistry:

"At the time it was originally proposed to teach Chemistry 2 lectures by closed-circuit television, considerable hesitancy was expressed by many members of the teaching staff. It was foreseen that there would be a number of problems which could not be completely eliminated, such as the inability to transmit color, and the limitations on use of the blackboard [the instructors were limited to the use of one five foot wide panel of the blackboard at any one time][1] because of the difficulty of reading from the small television screen, and related problems. There was also a natural hesitancy with regard to the possible physical and psychological effect on the instructor of working before the cameras, under the bright lights, and with part of the audience located remotely.

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[1] Brackets indicate editorial comment.

"It can be said after the semester's experience that two difficulties—absence of color and blackboard limitations—proved to be serious handicaps incapable of elimination with the present equipment. It was agreed at the start that if these or other limitations proved to be critically serious, as judged by reactions of the students and staff involved, the project would be terminated and we would return to conventional teaching procedures. Such a critical situation did not materialize. Although the opportunity was left open for any dissatisfied student to report to the Director of General Chemistry and request a transfer to a different group, no such request was made. Informal chats with students who were in the television receiving classes did reveal that the two factors mentioned above comprised their strongest objections to this method of teaching.

"The absence of personal contact with the lecturer was evidently largely compensated for by the fact that the students did have such contacts in both recitation and laboratory phases of the course.

"The experience of teaching under the lights before the cameras did not prove to be a serious matter. After the first shock test, little feeling of annoyance was experienced, and the instructor became readily adapted to the situation.

"The reactions of the staff were frequently expressed in open discussions at the weekly staff meetings. Early in the term, a 'wait-and-see' attitude predominated. Two or three of the four receiving room observers occasionally expressed enthusiasm for the project based upon their observation of the close attention and concentration of the students in the viewing groups and the fine visibility of most of the demonstrations. They observed that students involuntarily responded to the occasional questions asked by the lecturer, just as they would if present in the originating room.

"As the semester neared the close, the staff as a whole became less than enthusiastic about the prospect of continuing the study into the next term. The reasons most frequently expressed were: (1) That they felt the study was sufficiently complete from the experimental standpoint to justify its termination; (2) That the saving in teaching manpower in the lecture phase of the course was insignificant; (3) That they feared continuation of the study might lead to the adoption of this procedure as a permanent policy without its desirability and necessity being clearly demonstrated.

"That the majority of the staff involved directly in the project in chemistry is opposed to the indefinite continuation of the procedure as a long-term policy cannot be questioned. They are, however, agreeable to a continued study for another semester, in order to complete the experimental aspect. Several of the staff favor directing the project towards somewhat different avenues, such as its application to the recitation phase of the course, or the use of strategically placed receivers in the lecture room itself so that every student has a close-up view of the demonstrations, while other aspects of the lecture are received directly.

"There is little doubt in this writer's mind that instruction of chemistry classes by television is quite feasible as far as its application to lecture demonstrations is concerned. It has a very significant advantage in making the experiments clearly visible. If color and a large screen were available, it would be entirely practical, perhaps even quite desirable. With limited availability of high quality teaching staff, and with very large numbers of students, this method would be an important possible solution to the problem of giving efficient instruction. In our present situation, considering the serious problems of color and screen size, it would seem unwise to adopt the method as a regular procedure. Looking into the future, with improvements in television equipment and huge increases in student numbers, this conclusion may well be reversed."

Statement by Thomas Wartik, Assistant Professor of Chemistry:

"Let me say at the outset that the television instructional program in chemistry proved to be far more successful than I thought it would be. This was due, in large measure, to the fact that expected technical difficulties failed to materialize. I might also say that, as an instructor, I found the program quite stimulating.

"However, the most important basis for estimating the success of the experiment is the quality of chemical training which it gave the student. It is my opinion that, all other things being equal, the chemical training received by the television student will be slightly inferior to that received by the student in the lecture room.

"I shall not dwell on the obvious and much-discussed advantages and disadvantages of television instruction, such as novelty reactions, adverse physiological effects, blackboard coverage, etc. What I should like to point out is that television instruction has shortcomings which are not readily measured by student examinations. These shortcomings involve, primarily, what may be called the 'feel' for chemistry, without which one cannot be said to have an adequate chemical training. The feel for chemistry includes recognition of substances and reactions by characteristic colors, familiarity with certain odors, and appreciation of chemical apparatus.

"Suppose, for example, that a student is fascinated (as I often was and occasionally still am) by a piece of equipment on the demonstration desk. He will, most likely, wish to examine this apparatus, visually, both before and after the actual demonstration in which it is involved. The student in the lecture room will have the opportunity to do this, the television viewer will not.

"The lack of color, I felt, was our most serious weakness. In order to minimize problems involving color, it was necessary (on a number of occasions) to plan demonstrations which did not utilize it; thus, even the lecture room students were deprived of many color experiences they should have had.

"I believe that, all other things being equal, the only instructional advantage—and it is a real one—of television viewing lies in its ability to magnify lecture demonstrations which would normally be difficult or impossible to see.

"I might point out that, to the best of my knowledge, student reaction to the experiment was quite commendable. I do not recall hearing one adverse student comment after the program had been in operation for a week or two (neither, incidentally, did I hear any praise).

"In view of the preceding, it is my opinion that, although television instruction has proved practical, its use as a normal part of our chemistry program should be deferred until such time as it becomes an economic necessity."

Statement by C. G. Haas, Assistant Professor of Chemistry:

"Prior to the start of the semester I expected that two serious difficulties would arise in the course of the work:

1. The lack of color would result in a loss of an essential quality of many demonstrations and would possibly create a misleading impression.

2. The restricted field of vision for presentations on the blackboard would be a handicap for one, like myself, who desires to give material on board A, go on similarly to board B, and then refer back to board A while considering board B.

"At the conclusion of the semester these two conditions of television presentation, as we utilized it, still stand out as serious limitations for the teaching of chemistry.

"The lack of color is, I feel, a very serious limitation which can be solved adequately only by the obvious—the use of color television. An attempt to overcome the difficulty by the use of actual samples for the television viewers is only a half-way measure. In cases in which color change is involved, the student misses the steps in the change even if the end result is revealed by a sample.

"One may argue that the student may properly gather such experience in the laboratory. This is so, but it does not answer the fact, that, if demonstrations involving color are performed during the lecture, the student will see and perhaps remember a misleading-grey experiment. My reaction while serving as a substitute viewing room observer during the semester was one of discontent because of lack of color. I feel that this lack does chemistry an injustice.

"The matter of limited board space [an area five feet wide] is also a serious one when extensive notation is needed to develop a concept. The attention of a 'live' audience can be directed quickly back to a previous point, but the response of the television camera is at best sluggish. To be sufficiently fast, such shifts would probably be disconcerting. In any event the showing of successive limited fields necessitates a set pattern of observation to be followed by all students. I am not convinced that this is preferable to allowing each student to set his own pattern, as in a direct lecture.

"The alternative presentation of such material on prepared posters does not solve the problem because (1) the area available is limited by the television screen size and not by the writing surface; and (2) the step-wise development, which is lost on the poster, is essential for teaching. I fear that this restriction of limited field of vision will tend to result in less use of the board, an undesirable situation.

"In other matters the television approach seems satisfactory. The cameras were not distracting, either to me or to the students so far as I could observe. The lights were not bothersome nor were they disagreeably hot when the air-conditioning was functioning properly. The microphone cable, though something of a personal nuisance, is acceptable. I did not consider the remoteness of some of the class to be important, since a 'live' audience was present. I would, however, have serious reservations about teaching a class located completely in remote rooms.

"In summary, my impression was that my teaching was somewhat less effective on television than otherwise. The fact that no important differences were apparent as measured by the students' knowledge may merely reflect a greater effort on the part of the tele-viewers. As a result of my experience I would suggest that possibly the best use of television, in a chemistry course, is as a visual aid in providing an enlarged view of experiments directly in the lecture hall. Such viewing, then, would not be used for the entire lecture, but only for those demonstrations employing small objects, models, etc. In this way one could make use of some of the potentialities of the system without the disadvantages discussed above."

8-3-1-2 Statements by Instructors in General Psychology

Statement by Kinsley R. Smith, Professor of Psychology:

"First, the physical conditions. These were far less bothersome to me than anticipated. The cameras were unobtrusive, placed as they were in the midst of the class. The microphone required only little alteration of usual behavior, such as masking it when clearing one's throat, and once one got the knack of keeping clear of the wire, could be practically forgotten. The lighting was annoying the first couple of sessions, since the contrast between the instructor's area and that of the class was strong enough to prevent my perceiving the expressions of the students' faces. Either I adapted to this, or the difference in illumination must have been decreased [it was not changed], since I was very little bothered by this condition during the rest of the semester. The monitor receiver, off to the side of the class facing the instructor, was of little use to me except in preparing blackboard work before class began. During instruction I felt I had to assume a highly unnatural posture to observe the monitor.

"Second, the behavioral aspects—two of which struck me as highly unfavorable. One of these was the apparent effect of the 'television environment' on the face-to-face class of students in the originating room. These students seemed over-awed, probably by the microphones present near them to pick up their voices, and by the brilliant illumination. It was virtually impossible to arouse discussion in this group; questions raised were asked in such timid tones that even I had difficulty in hearing them. This condition lasted out the semester and I was unable to change it although I appealed to students, before 'going on the air' several times, to speak up. I believe this situation could be largely overcome by minimizing the presence of television conditions, e.g., reducing the difference in illumination between the areas of the instructor and the students; concealing the students' microphones; concealing the instructor's microphone; using an intimate classroom rather than the large lecture hall.

"More important than the above, from my standpoint as an instructor, was the loss of interaction with my students who were in the viewing sections. I did not expect to be bothered by this, but I distinctly was. On two occasions when apparatus difficulties necessitated bringing the viewing sections into the television originating room for an hour of face-to-face instruction, I felt the bearing, facial expressions, and surreptitious reading behavior of these students plainly indicated disinterest and apathy. I have never seen such an attitude in any face-to-face group I have taught, and I must admit feelings of frustration in respect to the improvement of these viewing groups.

"In summary, my reactions in respect to this experience in university instruction by television are that the physical difficulties are slight and can be overcome, but that the problem of the *interaction between instructor and student,* the essence of collegiate education, remains a critical one."

Statement by John F. Hall, Associate Professor of Psychology:

"I felt the experience of participating in the presentation of a televised course was an interesting and illuminating one. The following are comments about this particular participating experience:

"A. Physical Factors

1. From time to time the microphone cord became tangled which resulted in a certain amount of confusion.

2. In general, it was necessary to remain relatively stationary in presenting the material. Such confinement, at times, became quite irritating.

3. The limited amount of blackboard space that could be used presented certain difficulties in keeping material on the blackboard for a prolonged length of time.

4. Although the high intensity illumination was no problem at the beginning of the semester, the lamps became quite warm and uncomfortable during the warm days of the last month of teaching.

5. The arrangement whereby the students' questions or comments were picked up via a swinging microphone did not function satisfactorily.

"Many of these physical difficulties arose as a function of the newness of the program and an inadequate number of operating personnel. It would be expected that as the program continued, such difficulties could be eliminated.

"B. Instructor-Student Factors

1. There seemed to be some difficulty in obtaining class participation. Students in the television group seemed to be quite reluctant to answer questions or express a point of view. In general, the television originating room section participated only about ⅓ as much as the control section.

2. Although it was believed that demonstrations in the television situation would be superior, the results of a limited number of such demonstrations did not support this belief. For example, an elaborate ear model was used to demonstrate parts of the ear. It was reported by one of the class observers that a crude drawing placed on the blackboard showing the same parts was superior to the more elaborate model.

3. Certain class participation demonstrations could not be used because it was necessary to utilize material from the viewing sections, and it was too time consuming and awkward to obtain such data.

4. In sitting in as an observer on another television presentation, I was appalled by the lack of discipline and by the general confusion that was in evidence. Students seemed to be doing everything except looking at the screen.

5. Inasmuch as one never knows who is looking in the television receiver, the traditional sanctity of the classroom is abridged. Quite frequently, this results in a certain amount of inhibition in the presentation of certain material.

"To a large extent, the interaction between student and instructor that exists in a typical classroom situation is lost in television presentation. The 'live' audience seems inhibited; the viewing audience has no opportunity to participate. To the extent that this type of interaction represents a kind of reinforcement for the instructor's enthusiasm, and enjoyment in teaching, or to the extent that this interaction represents an integral aspect of the educative process, presentation of material by television has serious limitations.

"However, the evaluation of such a program by an instructor is difficult. For, one might ask, what does presentation by television have to offer the teacher? The traditional method of teaching is one that is familiar to the typical instructor. Presumably, it has also played a part in the individual's choice to go into the teaching profession. Thus, it would seem unusual for teaching by television to result in greater satisfaction for the individual than teaching by the traditional method. And, as I have indicated previously, to the extent that the interaction between student and instructor represents a major source of satisfaction to the instructor, then, from the instructor's point of view, teaching by television will not be liked as much as the traditional teaching method."

8-3-1-3 Statement by the Instructor in Psychology of Marriage

Statement by C. R. Adams, Professor of Psychology:

"The teaching of Psychology 17 (an elective course designed to give students perspective and preparation for marriage) has become increasingly a problem. Classes have tended to increase in size over the years. Other things being equal, the larger the class the higher the general noise level. This makes it more difficult for the instructor to be heard clearly and for motivation to be held at a high level. Further, the greater the distance of the student from the blackboard, the less readable the material placed upon it.

"Although the instructor was eager to participate in an instructional technique that made possible smaller classes, at the outset he had serious misgivings about the suitability of a closed-circuit television medium. The teaching of a marriage course seemed to him to be so personally directed that this method would create an artificial situation, and would lead to lessened student interest. Leashed as he would be to a microphone, he also thought that he would feel unnatural and would be unable to function effectively.

"The first lecture was not easy. The glare of the lighting, control of voice (avoiding coughing or other staccato vocalization), restricted movement, the worry that blackboard notes would not be legible on television receivers, etc.—in short, accepting and adapting to the mechanics of the television procedure, did bring about initial strain.

"By the third lecture, the instructor felt perfectly comfortable. To his surprise, only three or four students wished to be moved from a viewing room to the originating room. In all but one case, the reason was related to a visual or aural handicap; the exception was a girl who wished to be in the originating room because her fiance was in that section.

"As the course progressed, early misgivings were completely dissipated. The relative proportion of students in viewing rooms who sought personal conferences with the instructor was of the same order as for the originating room. (Rapport in these conferences was fully as good, if not better, with students from viewing rooms as from the originating room.) The same approximate ratio obtained for written questions submitted by students from the various sections, whether the questions were handed to the observers or left at the instructor's office. The questions submitted, and conferences requested, were relatively identical with what had been the case in the Fall Semester without television. As far as the instructor has been able to tell, the course lost none of its vitality. Neither he nor the students he has talked to have felt that television presentation is in any way inferior to typical classroom instruction for Psychology 17.

"This instructor has been greatly challenged by closed-circuit television. If at all possible, he wants to continue to teach Psychology 17 in this way. He now thinks that he can teach more effectively by television. He is certain that he has better rapport with students through small rather than large sections. He knows that teaching is less of a strain because noise level is lower, attention is more concentrated, and television techniques make possible through proper settings, appropriate use of telescopic lenses, and other devices not even explored, a greater versatility in presentation, in capturing attention, and in dramatizing important points. He further believes that the very presence of the cameras motivates him to prepare his lectures more carefully, to organize his material more effectively, and to do the best teaching job possible.

"He would hope that some high quality microphone system can be added to present equipment, so that the instructor has no dangling cable to restrain his movement or to entangle his legs. He would also like to experiment with a more relaxed studio setting that would relieve the drab classroom atmosphere. This would be particularly helpful in giving verisimilitude to certain types of illustrative dramatic life situations.

"In summary, this instructor is convinced that television teaching of Psychology 17 is far preferable to orthodox methods. He further feels that any present television limitations will be overcome as techniques and the art, generally, are improved. He is really enthusiastic about the possibilities and hopes that departmental planning and budgeting will make it possible for him to continue as a television teacher."

8-3-1-4 Statements of Observers of Television Classes

Statement by Philip S. Skell, Assistant Professor of Chemistry:

"Televised instruction removes the person-to-person contact from the teacher-student relationship. I believe this personal contact is an important and integral part of our educational program. Although our staff frequently could project themselves from the screen, I believe it would require a George Gobel capacity and staging staff to achieve at each performance the audience contact which one normally has in the average university lecture hall. If one is striving to produce a Gobel effect, it is plain that the production effort will be far in excess of the scholarly effort and may lead to a stereotyped course content in a field which is experiencing growth daily.

"In chemistry, (1) the absence of color is a serious difficulty which continually leaves the impression with a television viewer that he is not seeing all that he should see; (2) The limited field of view places a demand on students which many are not able to meet adequately. An experienced student rapidly adapts to the lecturer's technique and is able to record the important part of the lecture. The average student finds the shift of field often occurs when he has recorded only half of the preceding field (formulae, etc.), and when he attempts to copy from a neighbor he loses part of the material within the next field of view. (This feature has its advantages, for it may help to train a student to keep abreast of the lecturer.); (3) The limited field of view and the three areas of interest (lecturer, blackboard and demonstrations) require the presence of camera and control operators with both technical skills and a thorough knowledge of the course content to enable them to apportion time between each of the fields with the most suitable lens. Under normal circumstances a Chemistry Department staff member would be necessary for the camera (or control) operation to attain the timing appropriate for a lecture in chemistry.

"(1) The limited field of view focuses attention on the area of interest and eliminates many of the distractions which are normally present in all lecture halls; (2) Television is particularly valuable in the examination of small objects and (3) usually gives the remote viewer a far better picture than is possible by direct vision from the back of the lecture hall; (4) Lectures may be prepared with greater care until the novelty of the medium has worn off and lecturers return to their normal techniques.

"It is generally considered that there *may* be a shortage of teachers in the not too distant future. With this prospect before us, we should experiment with various techniques of large scale transmission of lecture content. However, there is no present need in chemistry for this type of lecture-extender at Penn State. It would be undesirable for the reasons mentioned above and the simple economic fact that the current technique requires in addition to the lecturer a camera operator, a person for operation of the controls, television class observers, and a repair crew. Further, one should not lose sight of the fact that the lecture hall is the training ground for new staff members, and that introduction of routine televised reproduction may discourage many novices who might otherwise develop into competent lecturers if they could start their teaching under less demanding conditions. Televised reproduction may develop star performers and simultaneously increase the teacher shortage."

Statement by N. C. Deno, Assistant Professor of Chemistry:

"1. Television has no marked advantage for freshman lectures in chemistry.

"2. The principal advantages of television are that the student has in general a better view of lecture demonstrations and that he sits in a room in which there are fewer distractions as compared with the ordinary lecture room. In some courses, television could result in a greater number of students per instructor and thus decrease cost of instruction. However, this effect is probably not realizable with freshman chemistry lectures.

"3. The principal disadvantage of the present television is the lack of color which is an integral part of many lecture demonstrations. The restricted area of vision and occasional technical difficulties [lack of good sound in early part of semester] are not important factors in my opinion.

"4. Most student reactions are neither strongly favorable nor strongly unfavorable."

Statement by Gladys Dawson, Instructor in Chemistry:

"At the present time I can see no reason why television instruction cannot be used successfully for large group lectures in General Chemistry. However, I do not believe that television techniques can replace completely 'live' teaching. I attribute the success of the chemistry experiment partially to the fact that the students maintained contact with instructors in both recitation and laboratory periods.

"I am not convinced that television for on-campus instruction would be successful in just any course; television instruction seems ideally suited to courses which have something to show the student. Otherwise a television presentation might tend to be dull.

"The outstanding advantage of television in chemistry is that each student has a 'front-row' seat for demonstrations and experiments. The obvious disadvantage is the lack of color. The need to focus attention on such a small area as the television screen is also one of the more undesirable aspects of the technique.

"The students involved in the television experiment did not seem concerned about their participation in the program. No one indicated that he was dissatisfied with the instruction once the technical difficulties [with sound] were overcome. Nearly all commented that they had a much better view of the lecture demonstrations than in the preceding course. The most frequent criticism was that familiarity with many of the chemical reactions shown could not be acquired because of the lack of color.

"It is not fair to the student or to the instructor if the important, but not spectacular, experiments in chemistry must be omitted from lectures because they do not show up on television. Therefore, rather than modify the course to overcome the disadvantages, I believe the television technique must be modified. Color television would certainly be outstanding. Even a projection type device for enlarging the black and white picture would be desirable."

Comments by Warren W. Miller, Associate Professor of Chemistry:

Dr. Miller preferred not to write a statement, but gave his impressions verbally. He pointed out that he was absent for part of the semester and therefore had only partial contact with a class in a television receiving room. He said that he personally does not like instruction via television but did not give any definitive reasons to support this point of view.

8-3-1-5 Statement by Observer in General Psychology in Television Classes

Statement by Joseph H. Grosslight, Associate Professor of Psychology:

"In general, the evaluation of television in a lecture-presentation course, as Psychology 2, is negative. This evaluation is not based upon the method of presentation by the instructor, but rather upon observed and interpreted student behavior and personal evaluation.

"At the beginning of the semester, interest and attention by the students seemed high. The general impression, as the semester progressed, was one of interest loss and loss of attention. As the semester progressed, students were slow in settling down at the beginning of the hour. On two separate occasions, a ten minute period was noted before papers were put away, talking stopped, etc. An increase in side activities seemed apparent, namely, paper reading, staring out the window, sleeping and talking. One thing was constantly apparent: About five to eight minutes before the end of the 50 minute period, increased activity in the class was apparent. In fact, as far as viewers were concerned, the last several minutes of presentation plus any overtime was wasted. The increased activity reported was well above the comparable behavior noted in any class. It seemed to me that students paid little attention, on many occasions, to the video component of the presentation.

"On a number of occasions, students either directly or indirectly made negative comments about television presentation. They asked very few questions; in fact, only one girl made out a question on a card and the question itself was suspect. The question periods in the originating class were lost for the viewers; at these times, talking and the like increased among viewers. At least two students never took a note after the first two weeks of class. It is my general, undocumented, impression that note-taking was at a minimum. In most classes, a few students stay around for a short time after class either to talk to the instructor or make some note comparison. This never happened in this viewing group; in fact, escape behavior was very apparent.

"This observer wishes to make one personal observation. After two or three weeks of watching the screen, an almost conditioned avoidance response occurred. My eyes began to burn, headaches increased, and I had to initiate side activity to maintain a waking state. This reaction to television persisted in personal viewing at home and is, just now, showing extinction.

"It is with some regret that this report is so negative. I truly feel that the loss of personal identification with the instructor in a university situation is unfortunate and to be avoided whenever possible. As an instructor, if I had been teaching a class, and students had manifested the reported behavior, I am sure I would have walked out of that class."

8-3-1-6 Statements of Observers in Psychology of Marriage in Television Classes

Statement by George Middleton, Graduate Assistant:

"In general, I am not very favorably impressed with instruction over closed-circuit television. I have no way, of course, of evaluating objectively instruction by this means, but I feel that I could learn about as much this way as I could in the conventional classroom situation, provided the course in the latter case depended primarily upon lectures to put across the material.

"I think the primary advantage of television instruction, aside from the greater number of students who can be taught by a single instructor, is that all students have a better view of demonstrations and experiments conducted by the instructor. On the other hand, this advantage suffers some limitation from the lack of color which in some circumstances is of primary importance.

"The primary disadvantage appears to be the lack of opportunity for members of the viewing sections to participate in class discussions concerning the material under consideration. Most individuals profit a good deal from such discussions, by bringing to the instructor's attention certain points which he failed to get across, and by pursuing some of the ramifications of the new material and relating it under guidance to knowledge previously acquired.

"A second disadvantage is that, in general, the students appear to be less motivated to attend to the lectures. Probably a number of factors are responsible for this relative deficiency in motivation, but perhaps one of the more important ones is that the students feel no need to pay attention out of courtesy to the instructor. If the students in my section became bored, they often slept, read newspapers and magazines, etc. Conversation between students was never a problem, however. Perhaps this was due to politeness and consideration of the others in the class.

"Very few students appeared to be enthusiastic about instruction via television. Most of them seemed to be either indifferent or negative toward it. The primary objection they raised was that they had no opportunity to ask questions or participate in class discussions. A couple of the less eager students said they liked being there in a viewing section because they could sleep without interruption. Oddly enough, there was very little complaint about some of the more technical aspects such as sound and picture quality. Most seemed to consider the transmission satisfactory after the shields were put on the sets [to prevent reflections of lights on the screen face].

"I think if two-way communication could be set up between the viewing and the face-to-face sections so that the instructor could proctor his own viewing sections, many of the disadvantages of television instruction might be minimized or eliminated. Ideally, such a system would enable the instructor to see as well as hear the members of the viewing section. It is possible that such a system would be even less practical from an economic standpoint than the conventional method of instruction."

Statement by Daniel K. Shirey, Jr., Graduate Assistant in Psychology:

"I only proctored the Psychology 17 class one day a week; therefore, I feel limited in discussing my impressions of television. Television as a mass media of education would seem to be an efficient method, but is this a *college education?* Due to the large number of students enrolled for higher education and the large number soon to be entering, some means has to be found to meet this situation. The advantages of television would seem to be: (1) a large number of students can hear and see one lecture, (2) it is less expensive than taking on additional instructors, (3) demonstrations, diagrams, illustrations and other materials of this nature can be observed much better by students on a television screen than from the twentieth row of a lecture room (I think this is the biggest advantage the student receives from television), and (4) in addition to a better view of visual aids, television also has the advantage of enabling the student to better see and hear the instructor.

"The disadvantages of television are: (1) its impersonal nature, (2) the student is unable to question and discuss with the instructor points in the lecture as they come up, (3) the student receives no individual attention at all, (4) quality is sacrificed for quantity, and (5) it doesn't really give an education. It is more of a mere memorization of facts for passing an exam.

"In trying to summarize what I think to be the opinions of the students I must emphasize again the limited time I had to observe the students. I felt that the students took the course rather lightly and possibly had some resentment about not being in the regular class. This could have been due to the course itself or the experimental nature of the television course. Generally though, the students seemed to take fairly good notes and paid attention to the instructor, though there was a good bit of conversation between students.

"The course might be modified so that the students would have a television lecture twice a week and a discussion the other period. By having the discussion periods on different days and hours with different groups fewer instructors would be necessary. The advantage of being able to observe closely demonstrations, illustrations and other visual materials on television could be used more efficiently during the lecture periods. The discussion groups would give the course the personal and individual touch necessary for stimulating interest and thought and the place to express it by questions and discussion."

Statement by Howard Sloane, Jr., Graduate Assistant in Psychology:

"1. Compared with the behavior of students in other classes, students in this section of Psychology 17 were what might be called franker. When a specific class was boring, they were very obvious (relatively) in expressing this, by ignoring the lecture in talking, newspaper reading, etc. When the class was good, or interesting, they behaved very much as any other students in traditional classroom situations.

"2. Note-taking appeared to be the same as in any classroom. Perhaps there were a few students who did not take notes at certain times who, in a class where they were actually confronted with the professor, would have made a pretense.

"3. From student comments I would suggest that motivation was rather the same as in any other class situation. Students came into the class with a certain amount of motivation, and, as in every other class this was affected by the professor and the subject matter, and the relationship of these to their expectations. Perhaps some students suffered a decrease in motivation due to the fact that after a time the novelty was not as great as it might have been, and perhaps what novelty there was increased the motivation of some few. I do not think that there was any loss of motivation due to lack of direct contact with Dr. Adams, although some of the students might believe this to be so. This is because Dr. Adams, in Psychology 17, as he has said, usually discourages the sort of contact that some students might look for as a source of motivation. With Dr. Adams in another class, or with a different professor, this might not be the case.

"4. In a classroom situation of this type, very simply I think we might say that learning is a function of intelligence, motivation, the professor involved, and mechanical technique. I do not believe that in this case the latter was affected by the media. Intelligence is not a variable of interest here. The professor, as stated above, is in this class very much the same in a television or live situation. Therefore I feel that any change in learning varied as motivation, which is discussed above, i.e., it was about the same as it would be in a live lecture.

"5. Some students stated that they learned more due to the lack of tension, and the lack of several types of disturbances. Research on learning, I believe, shows that some people learn better under mild tension, while some learn less, and this, I suggest, was also the fact in Psychology 17.

"6. As a general case, it would be my opinion that the relative success of the television classroom versus the live classroom is a function of the subject matter and the approach to it, and of the professor. As to the latter, I can only leave it at the general statement that some professors may be better on television than others, as some are better in the usual classroom than others. Although I would guess that the better teacher would be more likely to be better in both situations, I do not see why this should always be the case. Concerning subject matter and approach, I feel that we can dichotomize and say that some classes are more 'conceptual' as far as subject matter and approach, and that some are more a matter of remembering 'fact.' Psychology 17, I believe, is the latter. This type of class I feel will do as well or better on television as in a live section, for none of the variables that will affect such learning, such as those discussed in question four, the degree to which the situation permits focusing of attention, or the degree of relationship given to the facts, is affected by the media to a large extent. 'Conceptual' learning, though, I have found to be also very largely a function of communications and feedback, discussion, etc. To comprehend the statement that '40% of such and such is so and so' does not require two-way communications, but the statement that 'Man and culture develop contemporaneously' only acquires meaning in a two-way communications set-up, where it is clarified as small bits of meaning are added or subtracted from discussion and questions. This difference, I think, is the primary one in comparing television teaching with traditional teaching."

8-3-1-7 Instructional Film Research Program Staff. Charles McIntyre and Richard Watkins who were members of the TV Project staff also served as observers in the two psychology courses. They did not choose to write statements possibly for the following reasons: (1) They had dual statuses as experimenters and observers, and (2) They argued strongly that it was impossible to make observations and correctly interpret them because the effects of the instruction (content and methods), the personal influence of the instructor, and the reactions of students to televised instruction could not be separated.

8-3-1-8 Differences in Instructor Reactions between Chemistry and Psychology. The project was introduced differently in the Departments of Chemistry and Psychology. The introduction was more directive and forceful in chemistry and more time was spent on orientation of the instructors than in psychology. The chemists were more accustomed to working concentratedly as groups on problems of instruction. The group apparently had accepted what seemed to be strong but justifiable 'leadership.' The nature of the courses required close cooperation.

The conduct of instruction in the Department of Psychology has long been on an individualistic basis with a minimum of coordination among instructors, even with those teaching the different sections of the General Psychology course. A very limited amount of time was spent introducing and explaining the project to the instructors in psychology.

No evaluation is made here of which procedure is better. The only point is that instructional television, of necessity, was differently introduced into the two departments. Furthermore, there was far less overt disputation in chemistry than in psychology. The technique of using television was more favorably received and accepted in chemistry than in psychology.

8-3-2 Summary of Critical Essays of Instructors and Observers

The critical essays apparently were written by instructors and observers from the viewpoint of attempting to define problems and limitations. This is in the spirit of a research project. Instructors were not asked to list advantages nor were they asked to make constructive suggestions or plans for the future.

It may be useful for the reader to have the points made outlined briefly.

8-3-2-1 Outline of Comments of Instructors:

1. The "remoteness" of students and reduced possibilities of teacher-student interactions are serious problems.
2. Full "college education,"—the "feel" of the subject, cannot be presented over television.
3. There are unmeasurable characteristics of instruction.
4. The "sanctity" of the classroom is abridged.
5. Considering the amount of auxiliary help necessary, no manpower was saved.
6. The use of instructional television should be deferred until it becomes economically and practically necessary.
7. It was interesting to *have had* the experience of teaching over television.
8. The project was acceptable as an experiment, but evidence does not warrant regular operational use.
9. Some specific experiences were traumatic (these sometimes tend to generalize).
10. The physical arrangement was acceptable but there were problems with the lapel microphone and cord, lights (especially in the beginning), the monitor receiver was of little use, pick-up microphone for students in television originating room was unsatisfactory.
11. Furthermore, students in originating room were seriously inhibited.
12. A few trial demonstrations put on without preplanning were unsatisfactory (psychology).
13. Lack of color is a serious limitation for chemistry.
14. Restrictions in use of blackboard require changing habits of instructors.
15. Students cannot examine demonstrations after classes.
16. Instructors miss contacts and supportive reactions with students.

8-3-2-2 Outline of Comments of Observers:

1. Some courses are more suitable for television than others.
2. Remoteness from instructors is a problem.
3. Procedure may be justified when there is in fact a teacher shortage.

4. Use of the system may reduce emphasis on and discourage teacher training.

5. Reactions of students in receiving room must be evaluated in terms of the kind of course being televised.

6. Students seemed to accept television in chemistry; motivation and interest were lower in psychology. In the latter, interest may have decreased over the semester.

7. There were no classroom discipline problems in chemistry.

8. Classroom discipline was not normal for students in receiving rooms for psychology.

9. Viewing room students were freer to react to the *instruction* than when in a classroom before a professor.

10. In psychology, students sometimes did not attend to the "video element."

11. Sleeping was more frequent in receiving room classes than in regular classes (no comparative data).

12. Televised instruction concentrates attention; attention is concentrated too much; distractions are needed to keep students awake.

13. Close-ups increased visibility of demonstrations.

14. Televised instruction prevents attention by instructors to individual students.

15. The quality of education is sacrificed for quantity.

16. Instructors prepared their lectures better than formerly.

17. The way instruction is presented is of subordinate importance to the instruction itself.

18. To get projection of the instructor (the "Gobel Effect") the necessary production effort would be out of balance with the desirable scholarly effort.

19. Instructors have no way of knowing when points do and do not "go over."

20. Many students failed to take notes in psychology; getting all the notes written was a problem in chemistry.

21. Receiver screens for chemistry were too small (one receiver per room was used here).

22. Students could hear and see instructors better over television than in lecture hall.

Observers varied greatly in their work in the television receiving rooms. Some became restless, impatient and dissatisfied. Others seemed to enjoy the work and were diligent, helpful and constructive. The impression was formed from the observers in psychology courses that graduate assistants, or relatively inexperienced instructors, performed better as observers in receiving rooms than experienced or more mature faculty members. Faculty member *rivalry effects* seemed to be important. This rivalry and competitiveness can be positive and constructive, or the aroused aggression can be easily directed toward the mode of presentation. Furthermore, it seems very possible that the behavior and attitudes of the observers or teaching assistants may be reflected in the attitudes of students even when the role of these observers is a minimum one. These impressions should be considered and checked in selecting teaching assistants for television receiving rooms.

8-3-3 Reactions of Faculty Members Not Actively Associated with the Project

The introduction of instructional television even *experimentally* into the university was analogous to an approaching thunder storm during a hot summer afternoon. There were those who perceived the oncoming storm as a source of thirst-quenching water for the dry earth, plants, animals and men. Some anitcipated the prospects of cooling relief from heat and refreshing changes of the atmosphere. Others feared the storm, the accompanying strong wind and lightning. Some praised and others blamed the natural forces which produce storms.

No systematic opinion survey has yet been made of Penn State faculty members not actively associated with the television project. Nevertheless, much general discussion took place and it is now possible to describe some of the main characteristics of these reactions and to plan for systematic surveys in the future.

A great many faculty members were curious about and interested in the project. They went to viewing rooms and observed instructors, usually for brief periods. This was a unique opportunity for them. Generally, after even short periods of observations, the majority of faculty members expressed the opinion that the instruction and its presentation over television was "better than I thought it would be." Of course, some observers confirmed their prior negative opinions (see below), while still others were strongly enthusiastic. Often remarks were made somewhat as follows: "Is that what is taught in psychology (or chemistry)? I had not realized the course dealt with such (interesting) subjects." Or, "Professor so and so gives a splendid lecture (or lecture demonstration). It is good to know we have faculty members who are such excellent teachers."

The degree of faculty interest was indicated by the large number of requested demonstrations. Those who were invited to participate in demonstration telecasts almost invariably had their interests increased.

Levels of interest should not be interpreted to indicate directly a *favorable* attitude. Interests can indicate positive or negative attitudes. There certainly were extremes of views ranging from fear and hostility to this new "gadget for mechanizing education" to extremely positive, and perhaps unrealistically favorable reactions, such as, "This is *the solution* to the problems which we face in such and such a course." Generally, between these extremes the expressed interests of teaching faculty members seemed to be slightly more favorable than unfavorable to instructional television *applied on an experimental basis.* This trend toward favorableness, however, was saturated with a healthy skepticism toward television applied as a regular continuing means of instruction until reliable information is available. They also are somewhat anxious about what policies and practices will be adopted for the use of instructional television.

8-3-3-1. Factors Affecting the Acceptance of Instructional Television—Especially Student Enrollment Pressures. Faculty acceptance of instructional television varies greatly as a function of many personal, organizational and situational factors. Some of these determinants of acceptance are the rigidity-variability characteristics of instructors and their "feelings" of security or insecurity, the orientation of faculty members toward individualistic or cooperative teamwork, habit strengths and accommodations to accustomed ways of teaching and the ways of gaining satiisfactions from teaching. Age and maturity are also contingent factors. The network of personal relations and general "morale" of institutional and departmental organizations may favor or oppose acceptance of television as an instrument of instruction.

The courses involved in the television project, with the possible exception of the course in the Psychology of Marriage, did not have severe student enrollment pressures. Both General Chemistry and Psychology could have been taught in the Spring Semester of 1955 by usual methods without undue demands being made on available faculty members. The work with television was carried out experimentally in anticipation of future demands, and not as a direct consequence of existing pressures of student enrollments.

The reactions to televised instruction and prospective acceptance by faculty members in courses and departments where heavy student enrollments *already exist* are much more favorable than are those reactions where this condition does not now exist. This is exemplified by the strong interests and positive actions shown by faculty members who have been teaching large numbers of students and who are scheduled to use television next year. The favorable reactions of a professor who has taught as many as five hundred students each semester in Business Law, and is scheduled to teach next year over television, is a good example. He views instructional television as a possible means of relief from the previously unsolved problem of large student enrollments, and as a means of getting long-needed assistance with his very heavy teaching load.

The critical factor of faculty acceptance of instructional television will change in quality and degree as enrollment pressures vary. However, in order to insure or increase faculty acceptance, whatever the prevailing conditions, faculty members should be given full information on the problems confronting universities and the relevance of instructional television to these problems as well as its relevance to the faculty members themselves. It cannot be assumed that faculty members who have been concentrating for long periods on their heavy jobs of teaching and research have adequate or convincing information about these problems. Certainly they have not had opportunities to know of the relevance of television to the problems or to themselves.

The awareness of academic problems by university administrators cannot be assumed to be generalized to faculty members. For example, administrators may be keenly aware of and seriously concerned with the problem of cost of instruction, but rarely have members of a faculty been informed of the realities of this problem even though cost of instruction and teaching productivity relate directly to faculty salaries. Faculty members need to have sound and adequate information on this and a wide range of other problems related to instructional television. Such educational action has possibilities of affecting the degree of acceptance of this mode of instruction on the level of "rational" considerations. However, modifications of deep-seated emotionalized attitudes will not surely result from information alone. Indeed, strong adverse attitudes may effectively prevent the superior teachers, who are in all other respects qualified, from being available for instruction over television.

8-3-4 Statements of the Main Faculty Reservations About Accepting Instructional Television as a Means of Giving Courses

The following statements of reservations expressed by faculty members may help define the problems of faculty acceptance of television and indicate what needs to be done during the introductory and experimental phases of work with this medium if it is to be applied in college courses:

1. "It is impossible for students to ask questions.

2. "Discussions cannot be effectively conducted with the television-taught groups.

3. "Television interposes 'barriers' between instructors and students.

4. "It is difficult or impossible for an instructor to benefit from the subtle nuances of reactions and 'feedback' from students. The instructor cannot see the facial expressions, and other indicators of attention and interest, even of students in the originating room where the cameras are located.

5. "The instructor is removed from close contact with students, and this feeling of 'psychological distance' is a severe handicap for the instructor.

6. "Factual information may be taught effectively over television, but the full influence of instruction and the teacher's personality cannot be projected over television.

7. "Television may be all right for lectures or lecture demonstrations but it won't work in the courses I teach.

8. "Television is 'automation' in education. It will lead to a 'star system' for faculties. It will lead to unemployment and a more limited employment market for faculty members *in many fields*. It will limit the training of adequate numbers of young teachers. Let increased enrollments increase the demands for faculty members. This is what we need in the academic labor market.

9. "Objective test scores of the results of teaching are inadequate; instructors must *know* their students personally; teaching over television prevents this firsthand knowledge.

10. "Television will lead to cheap instruction, hence administrators will force this 'gadget' on the faculty.

11. "It is dangerous for college and university teachers to expose themselves and their teaching to public observation. The instructor's position on controversial issues may be misunderstood. It is very risky to permit administrators to observe how a teacher conducts his course. There will be differences of opinion, and the instructor may be 'fired.'

12. "The problem is one of economics. If the university, or some foundation has money to spend, let it be used to increase faculty salaries rather than spend it on television.

13. "Instructional television is just another way for administrators to increase the loads put on teachers, and we are already overloaded.

14. "Teaching before television cameras would increase the 'stress' on instructors who are already under too much 'strain.'"

These viewpoints are not merely hypothetical for many faculty members. They are real issues which must be further defined and resolved. Many are sincere questions which should not be summarily dismissed; the questions should be answered definitively, some by appropriate administrative policies and clearly formulated operational procedures, others of the questions require more and pertinent information than is now available. The information which is available should be given fully to all faculty members of institutions in which instructional television is introduced.

8-3-5 Possible Advantages to Instructors

What are some possible advantages of instructional television for faculty members?

1. Their productivity per hour of class instruction can be increased.

2. A means is provided for saving time in teaching large basic multiple-section courses and as a consequence faculty members can redeploy their time to improve instruction, to teach upper level undergraduate and graduate students, to conduct research and to engage in scholarly activities related to personal-professional development.

3. Instructional television should make it practical for faculty members to have more assistance in teaching large classes.

4. A means is available for faculty members to earn greater rewards for teaching, both in terms of salaries and professional recognition.

5. Television probably can be used as one means of enriching and improving instruction. For example, demonstrations, films, photographic and graphic materials, interviews, panels, forums, distinguished lecturers, and many other resources may feasibly be presented over television.

6. Television makes it possible to use the cooperative or team approach to instruction.

7. A new means is provided for teacher training for those who are interested and responsible.

8. Instructional television provides for some instructors needed and beneficial new challenges and added responsibilities.

9. Television instruction should require the restructuring or reorganization of courses and this, for many faculty members, is an advantage if time is provided for doing this.

10. By using television an instructor can influence far more students than with conventional limited class instruction, but even so he may save time for intensive work with exceptional individual students.

8-3-6 Faculty Responses to Invitations to Propose Courses for the Television Project for the 1955-1956 Academic Year

The best validation of opinions and attitudes is the willingness to take relevant action or the actual taking of such action. During the late Spring Semester, 1955, while schedules of courses were being prepared for the next Fall, it was generally suggested to some department heads and more often directly to instructors, that there might be opportunities for teaching some of their courses or specific courses over one of the television systems. The purposes of this procedure from the viewpoint of the project were to have courses which varied considerably in character available for experimentation in the Fall if the project were continued, and also to test realistically the acceptance of the project by 20 to 30 members of the faculty. The invitations were tentative because it was not certain, at that time, whether the project would be financed or not for another year.

Those responsible for General Chemistry decided to continue the experiment and to present all lecture demonstrations to about 650 students over the Osmond Laboratory television system next Fall.

The faculty of the Department of Psychology agreed to schedule two television sequences of General Psychology tentatively and to make a final decision after the full results of the first study were available. The course in the Psychology of Marriage was definitely scheduled for the Fall.

These moves were considered important because restrictions on the design of the project, especially in psychology, needed to be removed and further experimentation done. Also, gains toward acceptance of instructional television, if any, in the courses where it was used should be *secured* and stabilized. To move from course to course, even during experimental work, would reduce the realism and productiveness of the project.

The following courses involving about 33 instructors and between 3,000-4,000 students were offered for experimental purposes without commitments on the continued use of closed-circuit television in them: Psychology 2, Section 1; Psychology 2, Section 2; Psychology 17; Education 1; Economics 2; Music 5; Air Science 3; Speech 200; Commerce 30; Chemistry 1, Section 1, and Chemistry 1, Section 2.

The fact that these courses were proposed for the continued experiment, and that responsible instructors were willing to change, to adapt and to experiment with their own courses, were events which confirm and validate a reasonable level of interest and favorable attitude toward the *experimental* use of instructional television toward the project being reported.

There was one uncertain and one negative case. General Physics taught for non-majors was believed to be very appropriate for television instruction. One extension of the Osmond Laboratory television system would make it possible to televise the physics lecture demonstrations. It has been definitely decided by the instructors that this course will not be offered over television next year.

An unusual step was taken in the case of another basic general course, a physical science. It is a course of interest for television instruction because of the great possibilities of using pictorial-graphic materials very appropriate for the video channels of television. The director of the project, therefore, violated planned procedures and telephoned the head of the department and proposed to provide a television system for the course. The response was clear and negative even as to discussing possibilities of such a proposal.

No attempts were made to promote or to convince faculty members that television should be tried in their courses. Projects like this can be pressed forward too rapidly and thus court set-backs or failures. The approach adopted was simple and straightforward, and might be summarized as follows: "Observe the systems in operation. We are not selling television. This is the information we have and more is needed. There seem to be possibilities here that are worth considering and there are limitations, some of which may be overcome."

A very noticeable difference was observed in the responses of faculty members when instructional television was discussed as an experiment as compared with discussions which were based on assumptions that the television systems were permanently installed, had been accepted, and would henceforth be used regularly. The differences to these points of view were, it seemed, sufficiently strong to make it necessary to emphasize that the television project at Penn State was definitely experimental.

8-3-7 Stimulus to Research on Teaching Methods

A very important result of the project, which the reader may have noted already, was the amount of interest which was stimulated in *research on methods of instruction.* In spite of the importance of such research and its possible values, little or no rigorous investigations have been done at Penn State on the comparative effectiveness of methods of instruction. For example, the problem of effects of class size has not been studied systematically or adequately at this or any other university. Yet million-dollar-decisions are made annually on the basis of assumptions about class sizes. Therefore, it is a remarkable fact that, given the opportunities to experiment with comparable methods using television, 30 or more teachers in the university would be actively interested in doing so. Undoubtedly factors other than television *per se* led to the activation of this research interest.

8-3-8 Closed-Circuit Television as an Instrument for Research

Closed-circuit television seems to be an instrument which can be used for research problems. For instance, it would be possible to present controlled instructional content and methods to systematically varied groups of students. The same instructor could present, in other words, constant stimulation *simultaneously* to varied groups. Furthermore, film recordings of the instruction can be made and preserved for future presentation or analysis in relation to measured results. Oftentimes the critical deterrent to good experimentation is that of having inadequate numbers of subjects. Closed-circuit systems make it possible to have more subjects involved simultaneously than can be accommodated in most single classrooms. In experiments where systematic observations of the events being studied are required, e.g., teaching, closed-circuit systems provide a means of making these coincident observations without seriously interfering with the processes being studied. Using television cameras as observational tools is yet another research approach which should be explored. The intent here is to suggest that television makes research possible which otherwise would be difficult if not impossible.

Furthermore, it is highly probable that the best and most economical research approach for some problems in *broadcast* educational television could be investigated through closed-circuit systems.

8-3-9 Possible Effects on Faculty Colleagues

The way General Chemistry was taught illustrates a possible and worthwhile methodological result of the project related to improvement of instruction. It will be recalled that a team of three instructors rotated according to a plan of their own in giving the General Chemistry lecture demonstrations for the television classes. Frequently, while one professor was before the cameras and lecturing on a difficult topic or one of interest to them, the other two instructors would be observing over a receiver in the control room or in the visitor's room. Such observations, when made objectively and used constructively, could be most important as a means of improving instruction.

Furthermore, regular faculty members of the Chemistry Department accepted assignments in the television classes. For them an unexcelled opportunity was provided for critically observing during an entire semester excellent models of lecture demonstrations in their field and of making constructive suggestions about the course and presentation. This approach to teacher training or "on the job" training, could be of great importance in building adequate faculties.

8-3-10 Possible Effects on Teacher Trainees and Teaching Assistants

Both in psychology and chemistry at Penn State, graduate assistants are regularly assigned to help teach general courses. Three were assigned to the television project in psychology and worked as observers in the television classes. They were asked to make systematic observations and record them on a special form. These notes suggest that as teacher trainees these assistants learned much from their experiences. Their observations were acute, pertinent to questions of improving instruction and related to the needs of adapting courses and television techniques to each other. Generally their observations were constructive. These notes could be of great assistance to the principal instructors. Once again an important use of instructional television is revealed; namely, as an approach to teacher training, a seriously neglected task on the level of higher education.

A professor giving a seminar in college teaching sent his students occasionally to television visitors' rooms and receiving rooms to observe examples of instruction.

8-4 ATTITUDES AND REACTIONS OF ADMINISTRATIVE OFFICERS

A project such as that being reported which so directly involves university policies and procedures and relates so closely to central responsibilities of administrators at all levels, should not be undertaken, and would probably not succeed, without their approval and support. The help of administrative officers is needed at many points. Furthermore, risks are taken and possibilities are increased of issues and conflicts arising which commit administrative officers. They should not be thus committed without their full knowledge and approval.

Fortunately for the Penn State Project, the President and Provost were strongly interested in educational television. Extension of this interest to closed-circuit instructional television was not a very long step. Furthermore, these officers as well as the Secretary of the Board of Trustees were well aware, as a result of intensive study and planning, of the acute problems associated with inevitable expansion of the university. The solutions to many of these problems remain to be found. Their interest led to their full support of the Television Project.

The deans directly responsible for colleges where the project would be conducted also approved and supported it. This was perhaps due to the fact that one was a Dean of the College of Education and strongly interested in anything which promises to contribute to education; the other was Dean of the College of Chemistry and Physics and vitally interested in electronics, thus in television. (He is now the Director of General Electric's Research Division at Electronics Park.)

At Penn State department heads are given what are perhaps unusual responsibilities for the work of their departments, particularly when the departments are large like Chemistry and Psychology. The heads of these departments had been associated on projects of producing instructional films for teaching a complex skill in chemical training. Good working relations, shared ideas and many future plans transferred easily to the television project. Since these department heads negotiated the project, they were committed and hence gave all possible support to the work.

Administrative support of an educational endeavor is inseparably related to confidence in those people responsible for the work and to their previous successes and failures. Those responsible for this project including the staff of the Instructional Film Research Program appeared to have a favorable balance of credit with administrative officers. In summary, the Penn State Television Project had administrative backing from the beginning to the end of the 1954-1955 exploratory work. When results were available, the administrative officers and the Administrative Council were most interested in them as well as in their interpretations and implications.

8-4-1 Responses of the Board of Trustees

The members of the Board of Trustees of the University were well informed about the progress of the project by the President at the June (1955) meeting of the board. Trustees went on record as expressing their sincere interest in and moral support of the project. It is believed that the board will favorably consider financing the project in part when this becomes economically feasible.

8-4-2 The Problem of Financial Support for Instructional Television

The Penn State Television Project was not conducted during the 1954-1955 academic year as a true pilot experiment similar enough to full scale operations to provide a basis for accurately calculating all costs. The Fall Semester was spent preparing for work to be done during the Spring Semester. Furthermore, only about 150 students were served over television in General Psychology, 100 in the Psychology of Marriage and about 100 in General Chemistry. The Sparks system for psychology was operated only 9 hours per week out of a possible total of 40 or 45 hours of continuous televising per week. The Osmond system was operated only two hours per week for the lecture demonstrations in chemistry.

Details of the cost of equipment, installation and maintenance costs have been given in the appendix of this report. "Professional" type vidicon black-and-white television systems, lighting, auxiliary units, cables and receivers are estimated to cost an educational institution approximately $16,000. The question is how can an institution finance the purchase and operation of one or more of these systems. The following are suggestions which will need to be modified to fit different colleges and universities but they may be found helpful:

1. The system or systems should be purchased by the central administration. They should be assigned and installed where they can be used to help solve critical problems of instruction and for research. They should be used

for enough students, student hours or credit units to justify the expenditures. Clearly the equipment should be used by several departments, i.e., interdepartmentally, and the chances are that several schools or colleges may need to have access to the facilities. Steps should be taken to avoid the inefficient situation, so common in the use of expensive facilities in educational institutions, of permitting the television systems to be possessed and monopolized by special interests which would restrict their use below that necessary to justify all costs and maximum practical utility.

2. Plans to use instructional television in classes should be integrated with budget planning, and provisions made in the regular annual or biennial budgets for financing all except operating costs. As with the financing of buildings and facilities, plans to introduce television therefore will require perhaps two or three years of advanced planning by most institutions.

Since the kind of use of television being proposed is an integral part of the operation of an institution, it is strongly recommended that it be financed within the regular budgets of an institution. It should *not* be considered an extra item, a miscellaneous expense or a "side show." Accordingly, it should not be expected that special grants nor extra budget funds should ordinarily be required. Exceptions to this generalization should be made for research and development work, the results of which promise to make contributions of significance to many institutions or to education in general.

It should be observed that the ultimate validation of the acceptance of instructional television by the administrators or boards of trustees of educational institutions is their commitment to finance the activity.

3. It is believed to be practical, although this has not yet been demonstrated, for maintenance and operating costs to be financed at the level of the college, school or department in large universities. This will require adjustments in salaries, wages, supplies, and equipment categories of their budgets. All participating departments using the systems should share proportionately to amount of use in the expenses of maintaining and operating the television systems. Since department budgets cannot usually be radically reorganized on short notice, several years may be required to adjust them for financing instructional television. Furthermore, it may be necessary to develop new cost accounting procedures. For example, it is suggested that cost accounting at the department level be done in terms of cost of instruction per *credit unit* or per student hour credit.

8-4-2-1 Relation to Faculty Work Loads. The above approach, in addition to giving cost accounting on instructional television, would provide a much needed basis for adjusting faculty work loads which are so closely related to instruction costs. The method of faculty load assignments in terms of class or laboratory hours, disregarding the number and level of students served, or the other demands made on instructors, will be found to be inadequate for faculty assignments to instructional television. An approximate adjustment would possibly be a 2 to 1 ratio, and 3 to 1 in some cases depending on a number of variables. For example, assume that an instructor normally carries 12 class hours of lectures or lecture demonstrations per week. If he teaches one large section by television, this should probably be equated to two sections taught in the usual manner. Another adjustment which was used in chemistry, was the assignment of a team of three instructors to give the lecture demonstrations usually given by a single instructor and repeated four times either by the same or different instructors.

These considerations lead to the statement of several requirements all of which relate directly to financing instructional television:

1. Instructors who teach large numbers of students over television should have their loads adjusted to compensate for the increased responsibility.

2. The released time of instructors should be partially invested in adapting and improving the courses.

3. Instructors using television will need to have the help and support of assistants to operate the systems, to assist in television classes, to develop teaching materials appropriate to the course and television, and to assist with the improvement and use of tests and measurements.

4. From a cost accounting point of view, it is desirable, perhaps necessary, to operate instructional television systems efficiently enough, i.e., with sufficient students over enough hours, to either maintain normal instructional costs, if they are reasonable, or to reduce instructional costs and yet save funds to provide for the adjustments suggested above including the auxiliary or extra services and materials necessary for conducting and improving the televised course. It is believed that this can be made practical.

Cost considerations should be kept in a sound educational perspective. The use of closed-circuit television should *not* be viewed as a means of primarily reducing the costs of instruction although this seems possible and can be justified in some courses. This will be a temptation for some hard-pressed fiscally minded administrators. ***The central justifiable purpose of employing closed-circuit television is to maintain or raise standards of instruction, to serve an increasing number of students, and to accomplish these objectives within severe limitations of the number and quality of available faculties as demands on them are increased.***

There is another primary justification for using closed-circuit television: Many faculty members of colleges and universities are carrying such heavy teaching loads that they are presently harrassed and much overworked. They are suffering from *chronic accumulative fatigue.* These conditions are antithetical to the "style of life" of a scholar and of the productiveness of a superior creative teacher. Where overloads are real and relate to the teaching of large general courses, closed-circuit television may be a means of reducing the loads of regular instruction, especially for superior men, and of providing time and energy for creative scholarly development, for basic research and for demanding types of advanced undergraduate and graduate education. This function of instructional television will be understood and appreciated by thousands of instructors in the educational institutions of the United States. Furthermore, the needs to use closed-circuit television for this justifiable purpose promise to increase as we enter the enrollment crisis in college education.

8-4-2-2 Considerations Relative to Net Cost of Instruction. This is a case study of the net cost of instruction and number and academic level of faculty required to teach General Psychology.

During the Spring Semester of 1954, 765 students were taught in General Psychology using the system of multiple-sections taught by faculty members and graduate assistants in classes which averaged about 42 students. There were 4 professor-taught sections, 9 associate professor-taught sections and 5 graduate assistant-taught sections. When the net salary costs were used as a basis and credit unit costs were calculated it was found that the cost per student credit unit was $5.63.

For the Fall Semester of 1954, again using the established arrangements for teaching the course, 995 students were taught in classes which averaged about 43 students. There were 4 professor-taught sections, 8 associate professor-taught sections, 3 assistant professor-taught sections and 7 graduate assistant-taught sections. This semester the net salary student credit unit cost was $4.65.

Instructional television was introduced and used to teach 240 students during the spring of 1955. Omitting control groups, there were 3 professor-taught sections (one in the originating room and two in receiving rooms), and 3 associate professor-taught sections. The class size averaged 40 students. The four receiving rooms are considered to have been serviced by two graduate assistants. Under this arrangement the net instructional (salary) cost per student credit unit was $3.36. No costs of the television system or its operation were included.

A hypothetical but realistic arrangement for next Fall Semester 1955 could be the following: Two television sequences are planned with 12 classes, 10 of which will be taught over television. An estimated 770 students can be taught. The course can be taught by three professors and/or associate professors with the help of 6 graduate assistants. The instructor load adjustment can be a 3:1 ratio for time spent on televised instruction. This adjustment plus the services of graduate assistants will make available manpower for adapting and improving the course. With this arrangement, the estimated *net cost* of instruction per student credit unit will fall in a range of $3.36 to about $3.75 depending on the rank and salary levels of the principal instructors.

Several implications of these comparisons of analyses of different patterns of course management are apparent:

1. Larger numbers of students in the same size classes can hypothetically be taught by fewer but more experienced instructors.

2. Even so, the principal instructors may have their usual work loads reduced and thus gain time for improving courses or for other purposes.

3. Net credit unit costs can be regulated, i.e., reduced to an optimum cost. "Savings" in cost can be used to help defray the expenses of operating television systems, the costs of teaching materials, defensible salary adjustments, and other direct costs of instruction.

4. With instructional television there would seem to be an increased need for assistants for the principal instructors.

5. Scheduling of classes will need to be changed. Additional conventional classrooms will have to be made simultaneously available for use by a course. Thus, there will be less distribution of sections of a course over the daily-weekly time span.

An underlying assumption is that a reduction in *quality* of instruction shall not and need not be tolerated. Also it is assumed that the cost of instruction is becoming a critical problem which should be of mutual concern to the constituencies, boards of trustees, administrators and faculty members.

The analyses given above are of necessity very tentative. The project has not been conducted on a scale closely enough approximating actual operations to permit good cost analyses.

Clearly just as the per student credit unit cost of instruction is intimately related to the number of students taught in classes and in the course, so the added costs of using closed-circuit television relates to the number of students taught and the number of hours per weekly cycle that the television system is used.

The employment of a television system becomes economically feasible when the number of students is taught *at a reasonable per student credit cost,* and there is a sufficient differential between this cost and conventional costs, to finance the cost of operating the television system and provide supporting services and materials for adapting the course to television and maintaining or improving the usual quality of instruction.

This formulation of the economic feasibility problem assumes that standard costs for specific courses as well as standards for teaching effectiveness have been or will be established.

8-5 GENERAL SUMMARY OF REACTIONS AND ATTITUDES

Instructors and observers were critical of instructional television. Generally they were more negative than positive. These reactions may, in part, have been due to the fact that they were taking part in an experiment, and for such, a critical analytical attitude is appropriate. However, this factor does not account for the full range of negative attitudes and reservations toward instructional television. Although the instructors are willing to continue to experiment, only a few of the six are agreeable to accepting this as a regular mode of presenting instruction to classes.

The reactions of students were mainly neutral or mildly negative toward instruction by television in the context of the first 1955 project.

Faculty members, other than those directly involved in the project, are skeptical but a number (20-30) are actually willing to experiment with their own courses. Those who have had to teach large classes are most favorable to the possibilities. A few do not wish to be a part of the experiment.

Administrators are generally favorable and a few are enthusiastic about the potentials of instructional television.

Differences in these reactions and attitudes relate to many factors: the statuses, responsibilities, beliefs, values of the individuals, and perhaps most importantly, the degree to which individuals are informed about and have been concerned with the major problems of university instruction and their possible solutions.

8-6 VISITORS' REACTIONS

A number of people visited the campus during the year to inspect the Penn State Television Project and to discuss the applicability of closed-circuit television to their own problems. Included in this group were representatives from the University of Rhode Island, the University of Pittsburgh, New York University, Michigan State University and the University of Delaware.

On March 29 and 30 a Television Open House was held on the campus to acquaint interested persons with the Penn State Television Project and to get their reactions including criticisms and suggestions. At this time visitors were able to observe televised instruction in classes in psychology and chemistry and to meet together for a discussion of problems associated with televised instruction, administration, research, closed-circuit operations and equipment.

Visitors attending the Open House numbered twenty-one. Included were representatives from the following groups:

The Armed Forces

- USAF Academy, Denver, Colorado
- USAF Mobile Television Unit, Orlando, Florida
- Signal School, Fort Monmouth, New Jersey
- Quartermaster School, Fort Lee, Virginia
- Bainbridge Naval Training Center, Maryland
- Office of Naval Research, Special Devices Center, Port Washington, New York

Educational Organizations

- University of Iowa, Iowa City, Iowa
- New Jersey State Teachers College, Montclair, New Jersey
- Fund for the Advancement of Education, New York, N. Y.
- Educational Testing Service, Princeton, New Jersey
- Michigan State University, East Lansing, Michigan

Government Departments

- U. S. Department of Agriculture
- Office of Education, Dept. of Health, Education and Welfare

Commercial Affiliations

- Eastman Kodak Company, Rochester, New York
- Station WFIL-TV, Philadelphia, Pennsylvania
- Dage Television Division, Thompson Products, Inc., Michigan City, Indiana

In general, visitors' reactions appeared to be favorable toward the project. Some criticism was directed toward the manner in which television was used with respect to production procedures, suggesting that the medium was not being employed to its best advantage. Some improvement in this respect may have been possible within the framework of the experiment. (For example, a suggestion was made to have camera coverage of more student activity in the originating class.) However, here again, it became necessary to refer to the limitations defined for this project which required that current teaching procedures and subject matter content were not to be altered to favor television.

Acoustics in the receiving rooms, especially in chemistry, were felt to be rather poor. It was hoped that some improvement might be made in the future.

The advisability of having a class in the originating room was questioned. Some observers maintained that instruction might be improved if the instructor were to address himself to the camera and concentrate on the students in the viewing room, and not have any students in front of him. There was a discussion of the possibility of using television for testing student achievement.

9 Comparison of Penn State Project with Other Television Research Projects

BRIEF OVERVIEW OF RELATED RESEARCH

A survey of the existing literature on the effectiveness of television as a means of instruction reveals that such research has been conducted by two principal groups: (a) U. S. Department of Defense and other related agencies and, (b) colleges and universities. A number of the research studies will be reviewed briefly here, others are listed in the selected bibliography.

9-1 U. S. DEPARTMENT OF DEFENSE STUDIES

The various agencies of the U. S. Department of Defense have conducted or sponsored a number of studies on the effectiveness of television for training. In the main, these investigations have been controlled experiments.

As early as 1949 the Special Devices Center of the United States Navy, at Port Washington, Long Island began a study (20) to determine the comparative effectiveness of television, kinescope recordings and classroom instruction. Three groups with about one hundred naval air reservists in each group made up the population for the study. One of the groups received televised instruction, another received kinescope instruction, and the third received conventional live instruction. Two series of eight lessons (refresher course for officer pilots and a basic training course) provided the course content. Both television and television recordings (kinescopes) were found to be better or equal to local instructors (in about 77% of the comparisons). Live television and television recordings were about equivalent in their effectiveness (in 84% of the comparisons). Acceptability of television was rated high in 1949.

In another study (21) conducted by the Special Devices Center, an attempt was made to determine the effect on *retention* of televised instruction. The problem of best methods for teaching by television was given special consideration. Eight one-hour television lessons were broadcast to 160 groups comprising a total of 3,000 U. S. Army reservists ranging in rank from private to colonel. The groups received a pre-test before each lesson, a post-test and a delayed recall test three to six weeks after the original lessons. All grades of officers and men made significant learning gains after receiving the televised instruction. Tests on retention showed that both officers and enlisted men retained a substantial amount of the material over a period of from three to six weeks.

In September of 1951 the Signal School, Fort Monmouth, New Jersey, began a study (23) completed in January 1953, for which the stated objective was to determine the extent to which television could be used as an aid in presenting the various technical subjects taught in the school. The results of instruction in three subcourses of a technical content nature (principally radio and radar) were compared with standard classroom results. Evaluation was made in terms of pre-tests and post-tests, questionnaires, subjective observation and discussion. It was reported that instruction by television was significantly better than conventional instruction though it was felt results here may have been a function of superior instructors in the television courses. The study concluded that televised instruction was just as effective as regular instruction.

Concurrently the Air Force at Keesler Field was engaged in a study (6) to evaluate the effectiveness of closed-circuit television as an instructional medium in comparison with conventional methods of presentation and, as a secondary objective, to investigate the feasibility of making kinescopic recordings suitable for use as training films in specific courses. Two matched groups (120 each) of Air Force trainees were given a segment of an Electronics Fundamentals course, one group receiving conventional instruction, the other receiving instruction by television. Two instructors were alternated with the two groups and the two methods. The use of television proved to be equally effective as conventional methods of instruction. This proved to be true for all levels of student ability.

Still another study to determine the feasibility and acceptability of a short program of instruction via television as compared to regular instruction was undertaken by the Quartermaster Training Command in 1954 (1). Two groups (107 Quartermaster ROTC students at Houston University) were divided through random selection and given four lessons in a Food Service Activities series offered regularly during the third year of training. Again one group received instruction by television, the other received the instruction in the regular manner taught by the same instructor. Effectiveness of instruction by television appeared to be equal to that of classroom instruction.

Also in 1954 the United States Naval Academy, Annapolis, conducted an experimental study (2) involving the presentation of a small segment of a required course in electronics taught via television as compared to the same segment taught under normal conditions. Midshipmen totalling 840 (6 battalions of 140 men) were divided by splitting each battalion into two groups. Only two test lessons were involved. Half of a battalion received instruction by television and was tested while the other received regular instruction and was tested. For the second program (lesson) the groups were reversed, each receiving the contrasting treatment. All groups were given a pretest, an achievement test or post-test, and a test of retention six weeks later. The difference between the performance of the television group and the non-television group was small, the difference being 2%, computed on the basis of the maximum attainable score. The final advantage, in terms of attained learning as demonstrated by the scores on the retention tests, was in favor of the groups taught by television in both cases.

The most recent study (14), and possibly the study with results most favorable toward televised instruction over regular instruction, was the research done at Camp Gordon for the U. S. Army by the Human Resources Research Office of the George Washington University. In an effort to obtain a measure of the relative teaching effectiveness of televised instruction utilizing Army basic training subject matter, a comparison was made between televised instruction and regular instruction for 14 selected hours of basic instruction. Treated in the same study were comparisons between kinescopic recordings and regular instruction, between low and high aptitude on learning and retention effects of television, and between retention without further training and retention with kinescope review for low and high aptitude trainees. Two companies, each containing about 200 men, were matched for aptitude by splitting each company into two equal sections on the basis of Area I (intelligence) scores. Half of the group received regular instruction in a large lecture hall. The other group was divided into nine sections of from 12 to 16 trainees who viewed the lessons on television receivers, one receiver placed at the front of each of nine cubicles. These cubicles were plywood-separated rooms in a converted theater. Two instructors alternated between regular and televised instruction. Results obtained in the study led to three basic conclusions:

(1) Televised instruction by the method used was at least as effective as regular instruction.

(2) Televised instruction was more effective for lower aptitude groups.

(3) Televised instruction was remembered at least as well as regular instruction.

It should be noted that comparisons were made between large lecture hall groups taught directly and small television-instructed groups which were proctored.

In addition to the investigations conducted by the various service branches, a study by the Educational Testing Service for the American Red Cross should be noted (22). Results of instruction in a course in Home Nursing taught via television and by conventional procedures were compared. Facilities of KUHT-TV Houston were used for the broadcasts. Three experimental groups were involved in the study. One group viewed the 13 twice-a-week half-hour programs in their homes. Another group viewed the programs but reported for "practice" sessions at Red Cross headquarters. A third group received classroom instruction in seven two-hour sessions which included lectures, demonstrations and practice. Instructors for the groups were not the same. Populations were not controlled. The television students did as well on the written test as those who received face-to-face instruction. They did slightly less well on the performance test. Persons with practice and television did no better than those with television only.

9-2 College and University Studies

Investigations of the effectiveness of televised instruction conducted by educational institutions have generally not been as well controlled as those done in the military services.

In the winter of 1951 a nine-lesson television series ("Make A Dress—TV") was broadcast over the Iowa State College station, WOI-TV, with satisfactory results (17). There was no attempt at this time to make a comparison with regular instruction.

Also in 1951 Western Reserve University offered two courses taught by television (Elementary Psychology and Comparative Literature) over station WEWS in Cleveland (18). Raw scores of persons taking the course by television and the scores of students taking the course in the conventional manner at the university were compared. Students taking the course by television had median raw scores 17 points higher than those taking the course in the conventional manner.

A similar comparison was made at Iowa State College in 1953 (11) when a televised course in Elementary Psychology was presented, using the facilities of station WOI-TV. Additional comparisons, which included a studio audience group and a group viewing the kinescope recordings of the lessons were made. The television classes did better than three of the campus classes. The best scores were made in the kinescope class—possibly a factor of a discussion session held after the kinescope was shown.

A recent evaluation of the effectiveness of television was carried on at the University of Houston (8) when the results of instruction by television and conventional instruction for courses in Elementary Psychology and Elementary Biology were compared. Facilities of station KUHT-TV were used. Courses when taught by television were found to be as effective as when taught in the conventional way.

Two studies using television were conducted by Montclair State Teachers College, New Jersey. On April 30, 1952 a complete day's schedule (3) of classes prepared and produced at the college was televised (UHF) and received in thirteen public schools of Bloomfield and Montclair. In the spring of 1954, supported by a grant from the Fund for the Advancement of Education, the college made a major contribution to educational television research through a study (15) the purpose of which was (a) to determine what constitutes the good television teacher, and (b) to explore the educational feasibility of televising outstanding teachers presenting units of instruction which form a part of the school curriculum. Some attention was also given to the problem of finding a substitute for direct student-teacher interaction. Nine lessons in an American History series designed for the fifth grade level were prepared by a staff of selected grade school teachers, members of the college staff and students, and televised with what were judged to be satisfactory results. Such techniques as "mind reading" (teacher's anticipation of specific questions), panels, off-camera voices asking the kind of questions students would normally ask, etc., were arrived at qualitatively and recommended for use.

A reference to the work being done at the Chicago Teachers College (16) should be made. No controlled studies have been published. However, the college is engaged in a long range program of experimentation to test the moderate cost vidicon camera for use in a closed-circuit system as a practical *aid to instruction,* rather than for televising complete courses.

The studies enumerated above, though perhaps different in scope and design were nevertheless similar in purpose. All were concerned in some manner with the applicability and effectiveness of televised instruction. For the most part there was a general agreement in results and conclusions.

Broadly speaking, the Penn State Project in purpose is closely related to these studies.

9-3 RELATIVE DIRECT COMPARISONS WITH PENN STATE PROJECT

The Penn State Television Project is not an extreme departure from previous approaches, either in intent or execution; nor is it an exact repetition of earlier studies.

Whereas several studies were principally concerned with the problem of using television as an aid to instruction (Fort Monmouth) or as a means for presenting selected units of instruction (Keesler Field, U. S. Naval Academy, Montclair), Penn State, as did the University of Houston, American Red Cross and Camp Gordon studies, presented full semester courses in their entirety. Of significance was a similarity in basic design of the Camp Gordon and Penn State projects which stipulated that current teaching procedures and subject matter content were not to be altered.

As for general results and conclusions the studies noted were in basic agreement, i.e., that instruction by television, as measured, was not less effective than conventional classroom instruction.

There was, of course, some divergence on degree of effectiveness. Several studies went beyond the "not less effective than" evaluation. Included in this group with results favoring television over regular instruction were the Fort Monmouth and one of the Special Devices Center studies. In the Camp Gordon comparison, results led the experimenters to conclude that televised instruction was more effective than normal instruction for lower aptitude groups. Because of a greater homogeneity in abilities of the Penn State students it was impossible to make a similar comparison.

Only in two instances were the results of any of the comparisons in a negative direction: (a) In the Red Cross study though students in the televised instruction group did as well on the *written* test they did slightly less well on the *performance* test. The difference was statistically but not practically significant. (b) In the Houston University study students in the non-television biology group had scores slightly higher than those in the television group. The difference here was not statistically significant.

There were, of course, some stated reservations and minor diasgreements in the studies noted. The economic feasibility of televised instruction was questioned. In both the Keesler Field and the Quartermaster Training Command studies the recommendation was made that only on a real mobilization basis would televised instruction be economically feasible.

Some disagreement was in evidence on the problem of advisability of the studio class. A studio audience was held by some to be an effective adjunct to instruction. Opinions on the necessity for providing interaction between students and teacher appeared to be at variance.

Length of optimum learning sessions provided another point of disagreement. These and other points will no doubt receive clarification from future research.

9-3-1 Complete Course Presented Closed-Circuit

In a recent Joint Committee on Educational Television report on institutions with closed-circuit television facilities (12), twenty-nine universities and colleges were listed as having closed-circuit facilities. Of this number seventeen claimed use of the facilities for classroom instruction. Seven of these were medical schools. Indications are that most closed-circuit television instruction today is either supplementary to regular instruction or is in the nature of student training and program experimentation. Beyond a discussion course in Comparative Foreign Governments just completed this spring and presented via closed-circuit at the University of Iowa, no evidence has come to our attention to the effect that similar full length courses of resident instruction have been taught via closed-circuit in other institutions.

9-3-2 Feasibility in Terms of Cost and Practicality

The problem of the economic factors involved in presenting courses via television has not been strenuously attacked. In the service studies the production was handled by specially trained units using professional-type studio equipment. In the university studies production was in the hands of commercial studio personnel again using professional equipment. One study, for example, employed a staff of thirty. Most, of course, used a smaller but reasonably complete technical crew. The Penn State study has placed considerable emphasis on economic problems and has used moderate cost equipment, and limited numbers of operating personnel, some of whom are students.

Without exception[1] all of the studies reviewed employed the professional image orthicon camera chains.

9-4 AREA OF PENN STATE CONTRIBUTION

Those features of commonality between the Penn State and other television studies have been pointed out above. The Penn State Project had, however, a number of important differences both in technique and emphasis.

As stated earlier, the background for the Penn State project involved an interest in television as a means of extending the effect of outstanding instructors through the medium of closed-circuit television, thus providing one potential solution to the impending enrollment increases in colleges and universities.

Specifically, the project's objectives were threefold: (a) To study the relative *effectiveness* of unmodified courses (Psychology and General Chemistry) taught for a *full semester* over closed-circuit television using *moderate cost* equipment as compared with the same instruction given in the conventional manner, (b) To collect information on the acceptability of televised instruction presented to administrators, faculty and students, (c) To study problems related to feasibility (in terms of costs and practicality) of television used for resident university instruction.

Thus a great deal of emphasis is being placed on the teaching of representative courses for a full semester via television and on the developing of feasible and economical methods of doing this. Further emphasis is placed on the study of the acceptability of instructional television to students, faculty and university administrators. In this connection a concept of television presentation was used which differed considerably from the current professional one. The autonomy of the instructor was to be of paramount importance. Equipment and technical personnel were to be held to a minimum, and were to be at the service of the instructor. Still another aspect of the Penn State project was that of studying the feasibility of using and operating several closed-circuit systems simultaneously within the university.

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[1] As noted earlier Chicago Teachers College is using the vidicon camera with the purpose of utilizing television as a practical aid to instruction, in magnifying objects and demonstrations to make them visible to large numbers of students.

10—Practical Considerations

10-1 ADEQUACY AND DEPENDABILITY OF "MODERATE COST" VIDICON EQUIPMENT

As was stated in an earlier section of this report one of the main objectives of this research was a study of the *feasibility* of using vidicon type television equipment instead of the usual image orthicon type.

Since vidicon type live television cameras were relatively new and untested in a university context for day-in-day-out use, there was a legitimate question to be answered concerning their adequacy and dependability. A second question concerned the cost of maintaining and operating this type of equipment. It is possible that while the initial purchase might be lower, the actual operational costs might be high because of unsolved design problems.

These reservations proved in general to be largely unfounded.

10-1-1 Adequacy

It is generally agreed by all people who have observed the Penn State closed-circuit systems in operation, that the quality of picture and sound obtained from the moderate cost system is at least as good as (if not better than) the quality obtained from live telecasts on a good home receiver in a favorable location. The conditions of use in the classroom were such as to make what are acceptable standards for the home not quite high enough for classroom instruction. In fact changes were made in the sound system of the receivers for this reason. There is no doubt that the picture quality using video distribution was adequate.

10-1-2 Dependability

Dependability of operation is partly a question of good equipment design and construction, and partly a question of the competence of the maintenance staff. One good index of dependability is the number of breakdowns which occurred during the televising of classes.

During the semester eleven hours of class instruction were televised per week, or a total of 160 hours for the semester—130 hours in psychology and 30 hours in chemistry. Actually there were only three occasions when major breakdowns[1] occurred in psychology necessitating cancellation of the televised classes (the television viewing students were brought into the originating classroom). There were no times during the semester when a major equipment failure occurred in the chemistry classes.

The three major failures can be described as follows:

(1) The loss of sound in the television system owing to the failure of a diode in the audio-video mixer.

(2) A synchronizing generator failure caused by a defective connecting cable.

(3) The loss of the sound in the television film chain when showing a motion picture, caused by the burning out of an exciter lamp in the projector and the replacement of the wrong type of lamp.

There were a number of minor equipment failures when one of the two cameras was either "noisy" or temporarily out of action and the second camera had to be used alone.[2] In one instance a faulty coaxial cable connection in one receiving room in the Sparks Building necessitated bringing the students in that room into the originating room for the remainder of the period. Most of the minor failures were traced to noisy or otherwise unsatisfactory vacuum tubes in the camera chains, to the failure of resistors, diodes and capacitors, or to broken wires in the connecting cables. Some of these latter failures could have been anticipated and prevented from occurring by following a system of regular preventive maintenance. This was done to some extent but one of the principal operational problems in this connection was the limited amount of time which the student-engineers could give to this work. It is a real tribute to their energy that they were able to cope with the maintenance problem as well as they did, and that they were able to locate the cause and repair almost every failure.

An additional burden was thrown on the student-engineers because much of the equipment was new and had not undergone adequate check-out before being put into full scale operation. Thus the stabilizing period required by most electronic equipment occurred during operations instead of during an earlier and necessary "shakedown" period.

The general conclusion is that the moderate cost vidicon equipment of the kind used is adequately dependable in operation for class instruction. Its maintenance is within the capabilities of selected student-engineers *provided they have the time* and are given some additional specific training on the equipment.

Receivers. The 24" receivers proved to be very dependable in operation. Periodically checks were made on the linearity of pictures, and the adjustment of the audio discriminator coils. About 20 vacuum tubes were replaced during the semester.

Lighting. The lighting equipment proved to be very satisfactory in performance. No large wattage lamps and only two 500 watt lamps were replaced.

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[1] A major breakdown is defined as one which necessitated the cancellation of televised instruction in all of the receiving rooms.

[2] A minor failure is defined as one in which part of the equipment was out of action, but televised instruction could still be continued to all or most receiving rooms.

10-2 MAINTENANCE COSTS

Maintenance costs. Maintenance costs may be divided into two categories—the cost of replacement parts, and labor for engineering maintenance.

On the basis of the first semester of limited operation it is difficult to give an accurate estimate of maintenance costs because (1) so far as replacement parts are concerned major replacements are covered by the factory warranty, and (2) so far as engineering labor costs are concerned it is difficult to separate out labor devoted to installation or modification of equipment, and labor devoted to general operations and maintenance.

With these qualifications in mind the maintenance costs for the period December 1954 to May 1955 inclusive for the two moderate cost systems, the two industrial systems, and the twenty receivers were as follows:

Replacement Parts

70 vacuum tubes	$80.00
Miscellaneous parts: Resistors, capacitors, diodes, fuses, wire, etc. (Some of these were used in the conversion of receivers)	60.00

This does not include the following defective parts replaced under factory warranty:

(a) 1 vidicon tube
(b) 2 power transformers
(c) several equipment connecting cables
(d) 1 receiver picture tube

Labor

Engineering labor for the entire project including installation, modifications, and maintenance amounted to	$1,975.00

(The more experienced student-engineers received $1.50 per hour, the less experienced $1.00 per hour.)

Spare parts. As was stated in an earlier section of the report it was decided not to carry a large stock of spare parts on hand. However, it was found necessary to have a supply of vacuum tubes available for immediate use. A stock of 60 tubes for the Osmond system and 80 tubes for the Sparks system (valued at appoximately $170) was carried, and tubes were restored to stock as used. Also a supply of resistors and condensors, diodes, and coaxial cable connectors was always on hand. Major items carried for emergency use were:

(a) 1 vidicon tube	$345.00
(b) 1 viewfinder cathode ray tube for the cameras or control units	16.00
(c) 2 spare communication headset cords	30.00
(d) spare lamps for spotlights and floodlights	50.00

10-3 UNSOLVED EQUIPMENT PROBLEMS

The principal unsolved equipment problems relate to personnel, time and experience for engineering services on the equipment.

It is clear that regular preventive maintenance is required on this television equipment, also that there is a need to study alternative arrangements of the equipment system, i.e., to experiment with systems-engineering. Furthermore, at the present stage of operations it seemed desirable to have a student-engineer on hand to take care of any problems that developed while the system was in actual use. This requires personnel who have the time and experience to fulfill these functions.

It is believed that these problems can be solved within the normal context of a university and many colleges. During the present study engineering assistance was entirely on a *spare time* basis. The student-engineers carried regular and full loads of courses in engineering. It is clear that this arrangement is inadequate from the engineering viewpoint and imposes an undue burden and responsibility on the students concerned. A possible solution to the problem is to appoint one (or more) competent half-time graduate assistant engineers per system who would be responsible for the operation of the equipment and the training of as many part-time engineering student assistants as seemed necessary. These graduate students should have had a thorough training in electronics, which can be supplemented by specific training on the equipment. They would each devote 20 hours a week to the systems.

The equipment itself is undergoing continuous design improvement at the factory and there is a need for close liaison between the factory and the user so that new modifications can be incorporated into existing equipment, and operational problems can be reported to the manufacturer so that suitable design changes can be made. The methods for effectively implementing this procedure need further study.

The problem of video versus R.F. distribution of the picture signals to the receivers requires further study. While video is very satisfactory in terms of picture quality, it is possible that R.F. may offer advantages if the systems were greatly expanded.

Another unsolved problem was in the use of microphones to pick up questions and comments by the students in the originating rooms. While there are a number of possible solutions to the problem it now seems reasonable to assume that the problem would be reduced or eliminated if the lecture-discussion classes (e.g., psychology) were to originate from a small classroom, rather than the large auditorium actually used.

It is also clear that some attention should be given in designing new classroom buildings to the possible needs of television. This would include attention to control of light, acoustics, flexibility of seating, and ducts and outlets for coaxial cables, and ventilation.

The development of television receivers particularly designed for classroom use would also be desirable. This would include an audio system designed for high quality speech reproduction, and possibly arrangements for accepting video distribution.

10-4 Possibilities of "Low Cost" Equipment

It was decided during the planning stages not to risk the use of the low cost ($1500-2500) type of vidicon equipment in the regular televising of classes at its stage of development in 1954.

However, partly as a result of improvements in this type of equipment, and partly as a result of the study of its use in a number of situations (see Section 11), it now seems clear that there are many applications on a university campus for which this type of equipment would be adequate. It is entirely possible that it may be suitable for the regular televising of some kinds of classroom instruction, although this possibility will have to be checked by further research.

Recent models of low cost cameras (for example the Dage 60-A) have remote controls available for focus, lens change, iris adjustment, pan and tilt and electrical adjustments, which should greatly extend their applicability for university and college classroom use. The use of such relatively simple equipment would not only reduce initial costs, but should also reduce maintenance costs and engineering time requirements as well.

II—Other Applications of Closed-circuit Television at Penn State

In addition to using the television systems for televising courses for an entire semester, a number of other applications have been explored, particularly of the low cost systems.

11-1 AGRICULTURAL EXTENSION TRAINING

A low cost system (comprising Dage 60-A camera, 14" monitor and two flood lights) has been successfully used in two ways in Agricultural Extension training. First, the system was set up on campus and used to check out the visibility and method of displaying various materials (ranging from leather shoes to diseased wheat), that would be used in commercial television programs by the university extension staff. Secondly, the same equipment was taken out in the field and used in actually rehearsing county agents who would be giving television programs over commercial stations.

The faculty member doing this work has reported that the equipment is quite practical for him to operate himself, and that its use is having beneficial results on the programs ultimately presented.

11-2 COLLEGE OF HOME ECONOMICS

Two different uses were made of a low cost system in the College of Home Economics.

During a large Open House display of the activities of the College, it was desired to use a television camera to pick up special demonstrations of new types of sewing machines in clothing construction, the use of the rotary ironer, and the preparation of specific foods, and to relay these demonstrations to three large rooms where they could readily be seen by substantial numbers of visitors.

For this use a Dage 60-A camera equipped with a zoom lens, together with a monitor, a line amplifier and an audio-video mixer supplied picture and sound to three 24" receivers located in rooms 200 feet apart. The results were very satisfactory.

This use of television—that of "magnifying" small objects or demonstrations so that they can be seen by many people—is one of the most obvious uses of television. Nevertheless, there are undoubtedly many such applications on a university campus, and the comparatively low cost of the equipment makes its use practical.

The second application in the College of Home Economics was a training one. The equipment described above was used during four workshops devoted to the training of individuals who would give home-making demonstrations over commercial television stations. (See Figure 13.)

11-3 AUDITION LABORATORY

The university Psychology and Physics Departments have been conducting a study to determine norms for hearing by testing subjects in an anechoic chamber. During the period that subjects are undergoing testing in the chamber it has been impossible to observe them and to detect any actions which might interfere with the accuracy of the measurements.

A Dage 60-A low cost camera was placed in the test chamber along with a small fluorescent light which provided about 64 foot candles of light on the subject. The electrical controls for the camera as well as its power transformer and the 14" monitor were located outside the chamber. It was possible with this arrangement to obtain very satisfactory observations of the subjects. In this instance the department concerned has purchased a low cost system for permanent use.

11-4 COLLEGE OF ENGINEERING

The Ordnance Research Laboratory held an important symposium on the campus during June, 1955. There were more people in attendance than could be accommodated in the largest room available for the conference. Accordingly, the closed-circuit system in the chemistry lecture auditorium was used to televise the addresses of the keynote speakers and transmit them to a nearby lecture room where the overflow audience could be accommodated.

There are many occasions on a campus when this use of closed-circuit television could be made to advantage.

11-5 COLLEGE OF MINERAL INDUSTRIES

In the College of Mineral Industries, tests were conducted in the televising of some special equipment which is small or is located in a confined space, using a low cost camera. It was found possible to televise very satisfactorily demonstrations of the method of preparing specimens for study in the electron microscope. It was also possible to televise the actual magnified image on the viewing screen of the electron microscope.

11-6 OTHER SPECIAL DEMONSTRATIONS

During the semester a number of groups requested special demonstrations of the television systems:

AAUP, Phi Delta Kappa, Pennsylvania Psychological Association, School of Education Aviation Workshop, Chemical Engineering Teachers, Physics Open House, Electrical Engineering Open House.

These demonstrations have afforded people on campus and visitors an opportunity to become familiar with the general instructional possibilities of closed-circuit television.

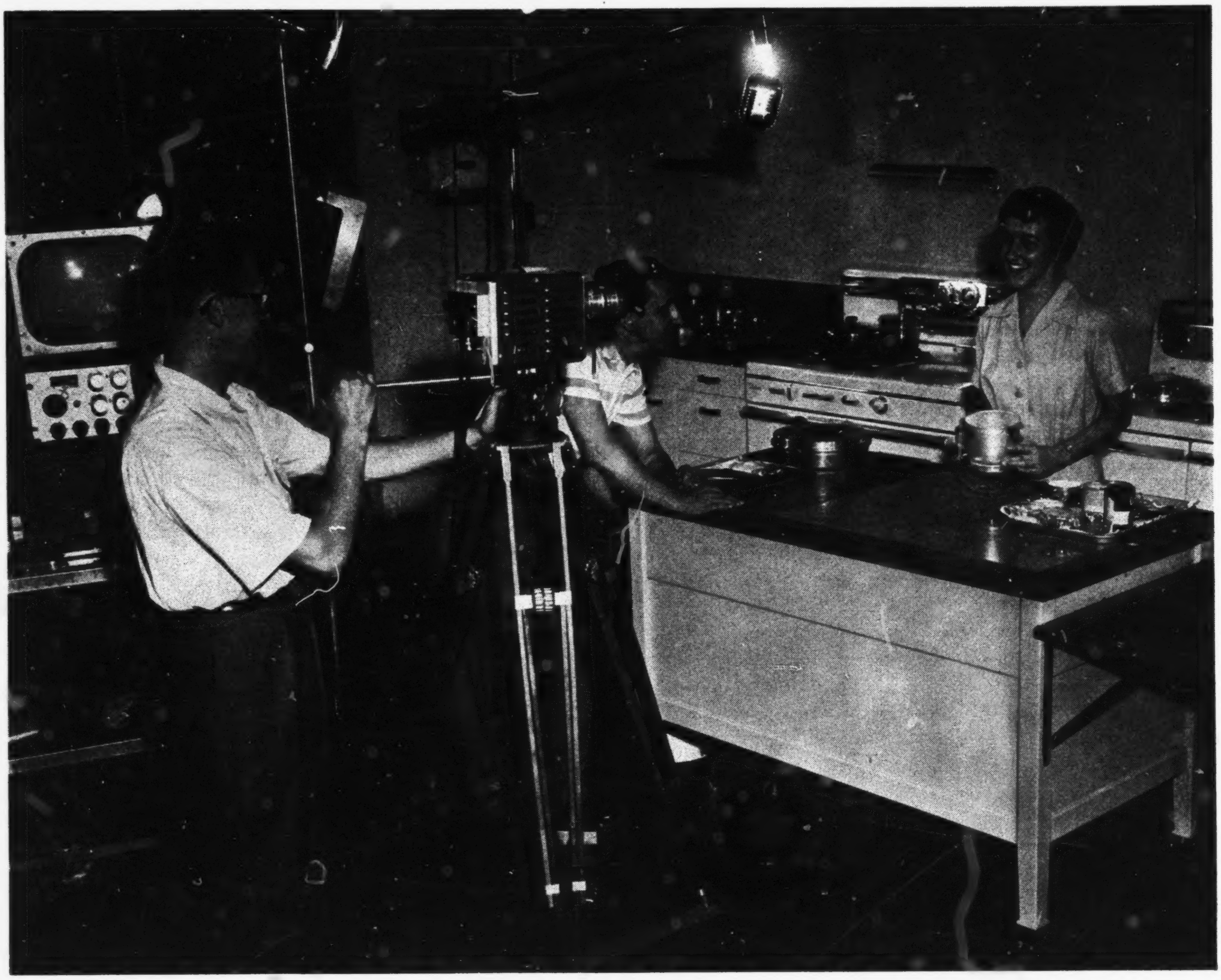

Figure 13. A Low Cost Vidicon Television System in Operation in the College of Home Economics for Training Students in the Presentation of Demonstrations over Commercial Television Stations

11-7 STUDENT TRAINING

Although not a primary objective of this year's activities, student training has nevertheless been an important aspect of the work. The availability of the television equipment on the campus has provided a facility of considerable value for training students in various activities related to television.

11-7-1 Formal Training

At the Pennsylvania State University there are several courses that afford the student formal training in television. Some of the courses bear the name television in their titles and others, such as courses in dramatics that have to do with lighting and scene-design, are not labelled as television courses, but have a direct relationship to television production.

Courses that afford practical training in television are Education 487, Unit C, Radio and Television in Education; Journalism 92, Radio and Television News; Journalism 94, Radio and Television Advertising; Speech 437, Principles of Television Speech, and Speech 540, Seminar in the Problems of Radio and Television Speech.

During the summer session Speech 437 and Education 487, Unit C, have been combined to form a Television Workshop especially aimed at aiding public school personnel and community leaders in producing educational television programs over their community stations.

The availability of the moderate cost television equipment has greatly enhanced the value of these courses in that it has afforded practical laboratory experience that previously was available only by taking the students to commercial television stations.

Speech 437, Principles of Television Speech, made use of the television equipment in student productions of class-written scripts.

During the last semester students produced nine programs using the Dage equipment. Students were rotated in the various tasks to afford the broadest possible training. On one program the individual might be a director, on the next a cameraman and on the next a performer. This type of training with actual television studio equipment has been of such a practical nature that it has led to jobs at commercial stations for some of the students involved.

Speech 540, Seminar in the Problems of Radio and Television Speech, deals in part with research problems in the field of television. Last year with the television equipment available, the Speech 540 class conducted an elementary project in determining the most effective positioning of the television camera in the originating classroom as judged by the student viewers in a remote classroom connected by a closed-circuit cable.

Students in drama and journalism also used the closed-circuit systems in connection with their class activities. As was mentioned above, the systems will also be used during the summer sessions for several special workshops.

11-7-2 Informal Training

The presence of closed-circuit television equipment on the campus afforded a number of opportunities for informal or on-the-job training for students and faculty.

Students from Speech 437 were encouraged to act as camera operators during the televising of classes. Practically all of the engineering maintenance was provided by students in electrical engineering, thus giving them an opportunity of gaining experience in television engineering. Several of the students were given additional training at the Dage factory.

Several faculty and staff members learned to operate the cameras and perform the switching operations on the camera controls, and of course all faculty members who appeared before the cameras in classes gained experience in making educational presentations over television.

12—Major Unsolved Problems Relative to Instructional Television

Electronic engineering developments have very recently and with dramatic suddenness made television available for use in education. Television is so new in some respects as a mode of communication that its use for *any purposes* must be considered as exploratory and in the pioneering stages of development. In this country, television as a channel for advertising, public information and general culture continues to be extended on a vast scale even though many basic questions relative to its effects on human populations remain unanswered. Whereas, in commercial enterprises profit and loss may justify and validate the use of television, the educational employment of it must seek other evidence and use different validating criteria. In a sense, the basic questions in which educators are so seriously interested begin where commercial interests shade-off in importance; namely, the more enduring effects on human experience and adjustive behavior.

The fact that television applied in education, closed-circuit or broadcast, is in an embryonic stage of development should be clearly recognized. The apparent potentialities and limitations may then be accurately characterized and defined by further study. Thus, a justifiable rate of extension and application of instructional television can be fostered. The overenthusiastic acceptance of an unproven instrument, or one not adequately proven, may be tempered and moderated. Set-backs and retrogression may be avoided.

There are many more unanswered than answered questions about the application and adaptation of instructional television for the achievement of educational objectives. The investigations of the functions and effects of instructional television including the study being reported have been preliminary, exploratory, and inadequate to provide sound conclusions which may serve as a basis for intelligent action. The values and possibilities are so great that commensurate and correctly assessed means must be used in achieving and materializing them. Research and development work is one of these means.

What are some of the major unsolved problems related to instructional television?

12-1 Appropriateness of Television for University Courses

It must be determined for what instructional television is and is *not* appropriate. Neither instruction nor television are homogeneous entities.

Instruction may encompass a vast range of content presented for students by a great variety of means and methods. A great number of implicit or explicit educational objectives may be involved. The full ranges of individual differences of both teachers and students, and their interactions, importantly affect the instructional processes. Furthermore, teaching and learning occur in greatly varied conditions or situations.

Likewise, television has many variations. Flexibility and variability of systems and modes of application are desirable characteristics. Possibilities exist for ingenious and inventive ways of increasing the flexibility and variability both of physical systems and modes of application.

Accordingly, a basic operational problem which demands thorough exploration is that of determining the *appropriateness* of application of different arrangements of television, differently used, for teaching a very wide range of courses or parts of courses over the full range of university courses and curricula.

The problem may be broken down into a series of short questions: What systems assemblies should be used? How should these be employed? For what objectives, content and instructional methods is the particular system effective? What specific instructors can use effectively this mode of presenting instruction? What kinds of students can be stimulated to learn effectively over television? Under what arrangements of buildings and facilities can television be appropriately used? Even the complex characteristics of the "climate of opinion" in an institution, "morale," the interest in risks and explorations, and acceptance of responsibility, relate to the broad questions of appropriateness of television for an institution as a mode of presenting instruction or channeling the instructing-learning processes.

12-2 Reciprocal Adaptation of Courses and Methods with Television

A second basic problem which is closely related to appropriateness is that of how reciprocally to adapt courses, methods of instruction and television. Ways of using television can be varied, and so can instruction and study. Stereotyping of any of these is probably undesirable. The problem becomes that of how and to what extent adaptations can and need to be made and are justifiable in the interest of the greatest possible *efficiency* and *productivity* of the educative processes.

This general problem goes beyond determining for what instruction defined television systems and patterns of use are appropriate and deals with the questions of what are the *possibilities* and *potentials* for the use of television with modified courses or their elements.

12-3 PROBLEM OF INSTRUCTOR-STUDENT INTERACTIONS

Let it be assumed that the area of greatest intensity of instruction is that of the students' interactions with instructors. Furthermore, let it be agreed that tele-education, the instructing, stimulating or informing people at a distance from the source, restricts and limits immediate, overt and reciprocal interactions. Then the general problem can be broken down into several specific problems. Determine the contributions to learning of those currently sanctioned methods of instructor-student interactions. Determine the optimum ranges of kinds and degrees of such interactions relative to defined educational objectives and *instructor-student satisfactions.* Define the *contributory functions* of these optimum interactions. Determine how and to what extent these contributory functions of instructor-student interactions can be subserved over and through the communicative unidirectional channels of television. Determine what kinds and amounts of two-way communication can be used and justified by evidence in terms of effects on learning or student-teacher rewards. Determine what supplementary or substitutive methods need to be used to compensate for non-adaptive limitations of television.

There is a great range of possible solutions to these problems. Those solutions that are desirable, defensible and feasible must be defined by systematic and objective exploration.

12-4 THE CLASS SIZE PROBLEM

This general problem has been outlined in an early section of this report. The problem lies at the heart of both the anticipated enrollment crises in universities and the use of instructional television. When the problem is phrased relative to closed-circuit television only, specific questions can be asked: What is the optimum number of students, if any, for the originating room? How should they be accommodated? What are the optimum sizes of viewing classes relative to sizes and number of receivers? What are definable limitations on the numbers of students who can be instructed effectively in large lecture halls, in chains of linked classrooms and in combinations of these arrangements?

12-5 OPTIMUM USE OF THE VIDEO CHANNELS

If there is a "new dimension" of communication in television it is a part of the mechanism of registering, transmitting and presenting *visual materials* (stimulation), in other words the *video channels.* The audio channels are essentially the same as those of radio.

Granting that human speech has vast ranges of potentialities for serving the functions of communication and hence instruction, the full ranges of the communication processes are not encompassed within the limits of spoken language. In life-like situations visual elements play important roles: The context of the communication may be contributory. Facial expressions and gestures, as well as gross postural and action patterns add to and qualify the significance or meaning of the communication. Visual signals, signs and symbols or pictorial representations of objects and processes reinforce the perceptual, learning, cognative and affective processes. The full and adequate representation of things, objects, processes and situations defies the limits of verbal and written symbols.

Traditionally, instructors are drilled in the skills of verbal communications. The potentials and functions of visual communications and the skills of using them have been grossly neglected. After all, instructors are probably selected, in part, because of their verbal abilities and propensities.

In order to attack the problem of making optimum use of the video channels of instructional television two tasks challenge investigation and solution: First, we need to know much more than is now known about the basic functional efficacy of visual elements in communicating knowledge, how these visual stimuli reinforce and supplement other kinds of abstractions including the verbal, and the processes of interaction of the various vehicles of meaningful communication. Secondly, there is the real and practical problem of having to change traditions and "styles of work" which are so firmly established with faculty members.

The video channels are available with television. How to use and not to use them and how to justify their employment are research problems. How to get the skills for using video channels developed and accepted in actual practice is another area of required action. Relative to the latter, the probabilities are high that the services of men with special competencies will need to be made available to assist instructors in the neglected areas of visual communications. Practical methods of providing this service is yet another area of study.

12-6 PROBLEM OF STUDENT ACCEPTANCE

The problem of student acceptance (and public acceptance) of televised instruction is not one which can be solved definitively and finally. It has been reported that student acceptance, among other factors, relates to the content of the course, the methods of instruction, and to the personality and competencies of the instructor. This will be and probably should always be the case.

Research can explore two important facets of the question of student acceptability. Those factors and conditions which affect student acceptance *negatively* can be delimited, and steps specified for eliminating, reducing or compensating for these *negative* factors. Conversely, those factors and conditions which affect student acceptability *positively* can be delimited, and steps specified for accentuating, improving or making more use of these *positive* factors. This is a critical and urgently needed area of research. There are many possible approaches and solutions which have not been tried.

12-7 PROBLEM OF INSTRUCTOR ACCEPTANCE

This report reflects the opinions and reservations of a very small sample of university instructors toward instructional television. These attitudes, furthermore, are based in the perspectives of these particular instructors, on limited experience with television and without reciprocal adaptation of television and courses. Nevertheless, it is very clear that these reactions approach the definition of a critical problem area about which more information is needed. One formulation of the problem for study is this: How can the *balance of incentives* and *rewards* for faculty members, including personal satisfactions, be adjusted so that, if the use of instructional television can be justified in all other respects, instructors who *should* use the system will *want* to do so?

The approach of making analyses of *positive* and *negative* factors and using the results intelligently, as was suggested for students, may apply equally to the problem of faculty acceptance.

It is imperative that this general problem be studied thoroughly and general guides for its solution be found at an early date. Unless this is done quickly and thoroughly, instructional television may act as a selective filter to screen out precisely those superior mature teachers who are most needed for using the instrument.

12-8 SYSTEMS RESEARCH PROBLEMS

Instructional television needs to be studied from the point of view of *systems research* with the human factors brought sharply into focus. However, the most urgent need is for research and development work on the engineered electronic systems. It is necessary to recognize the fact that most television equipment has not been designed and built for the purposes of presenting full university courses to large numbers of students. In one sense, television systems have been *transposed* from the intended areas of application to an unintended use as a means of presenting instruction. Consequently, changes and modifications required by the latter use need to be defined and clearly specified. Redesigning may be necessary in a few instances but mainly the problem is one of determining what the best combinations of equipment assemblies are for given instructional functions.

Furthermore, it is recognized that the development of television is undergoing rapid change, and improvements are being made. The "antiquation rate" is high. Revolutionary changes like the recording of both picture and sound electrically on magnetic tape are anticipated. Likewise color television may be available to universities in a few years. Such developments can be expected and indeed should be encouraged. Therefore, if the equipment of the future is to be suitable for the needs of education, these needs must be defined and made known to engineering designers and manufacturers. This problem necessitates close cooperation between those who are exploring the field of applying television in education and those who design and make the equipment. This will be a continuing task for many years.

12-9 PROBLEM OF THE RELATIONS BETWEEN CLOSED-CIRCUIT AND BROADCAST EDUCATIONAL TELEVISION

The factors of the *remoteness* of target audiences and classes are common to broadcast and closed-circuit television. They vary mainly in degree. Likewise, there are similarities in terms of the problem of "feed-back" or reciprocal responses. The broadcast audiences are said to be "non-captive" and classes are said to be "captive." Since it is possible to *control* and regulate classes or audiences for research using closed-circuit systems, a great range of problems can be investigated which are of central importance for broadcast television. Thus, possibilities exist for *experimental closed-circuit television laboratories on the functional problems* related to behavioral reactions and effects of television on people.

12-10 THE PROBLEM OF IMPROVING MEASUREMENTS

Perhaps the problems of improving measurements should have been listed as the first basic unsolved problem. There are several challenging phases of this general area. Measurement techniques must be selected and/or developed which are appropriate and adequate for the objectives of the instruction. This need is widespread and well known. The requirements for measuring effects of instructional television simply accentuate the great need for better measurements of all facets of academic achievement, especially in those areas other than informational learning.

Television presents special needs for two measurement developments: First, possibilities should be investigated for presenting a wide range of different kinds of tests and examinations *over* television. Secondly, the possibilities of pictorial, graphic and sound motion picture tests should be thoroughly explored. This latter is especially important for subjects like science demonstrations and laboratory work, but also for other *visually* taught subjects. There is a strong possibility that attempts to measure by verbal tests alone instruction presented over audio-video channels, when pictorial materials are used extensively, truncate or attentuate the results. Both still and motion picture tests can be developed.

12-11 SUMMARY STATEMENT

Clearly these selected problems and many other possible ones indicate the need for intensive and continuing research and development on instructional television.

13—Future Plans

Future work on instructional television at the Pennsylvania State University depends directly on two main factors; financing and interests of the university faculty.

There should be two sources of financing of the project related to its major functions. To the extent that instructional television is proven, accepted and used for regular continuing teaching, this proportion of costs should be financed by the university from general funds and from department budgets. To the extent that the activity involves research and development work, the results of which will be generally available to other colleges and universities, this proportion of costs should be provided by cooperative financing.

The second main factor which will shape future plans, faculty interests and their acceptance of television as a mode of instruction, is fluid and remains to be structured or determined. The interest of the faculty in exploratory research is promising for many important future developments.

13-1 Plans for the Fiscal Year 1955-1956

Generally, plans for next year will involve securing the limited gains which have resulted from the project during 1954-1955, and of pressing forward the research and development work on a broad but defined front.

The agreement of the Pennsylvania State University with the Fund for the Advancement of Education for the year 1955-1956 outlines the objectives for this period:[1]

"1. To extend the project to include eight or ten different courses with an enrollment of about 3,000 students in order to answer many additional questions related to considerations of appropriateness and feasibility of television to various kinds of courses. The list of courses nominated for TV closed-circuit participation includes Psychology 2—Introduction to general psychology; Psychology 17—Development of sexual behavior and sexual adjustment in adolescence and adulthood, adjusting in marriage, etc.; Education 1—Social values of public education; Economics 2—Methods of economic analysis and their use; Music 5—Recitation and lectures with recorded examples of melody, harmony, rhythm, vocal and instrumental timbre, form, and program of absolute music; Speech 200—Fundamental principles and methods of selecting, analyzing, evaluating, organizing, developing and communicating information; Air Science 3—Practical and theoretical instruction in leadership; Chemistry 1; Chemistry 2; Elementary Business Law, Elementary Accounting, and Economics 2, Principles of economics.

"2. To study variables of class size and patterns of instruction adapted to television.

"3. To develop specifications of basic requirements for adapting large college courses to closed-circuit television and of adapting television to the requirements of courses and instructors.

"4. To continue to explore the potentialities of closed-circuit television as a means of training college teachers.

"5. To continue and expand the application and testing of low cost television systems, especially in liberal arts courses, science laboratories and clinical psychology training.

"6. To continue to work on the problem of faculty and student acceptance of television as a means of classroom and laboratory instruction.

"7. To develop further than has been possible this year, means of solving problems of engineering and maintenance services within the limits of resources available at the university.

"8. To continue to provide information and consultation services to the increasing number of educational institutions interested in installing and using closed-circuit television for instructional purposes.

"We understand further that an effort will be made to obtain support to work on the following two additional objectives:

"1. To experiment with practical methods for making adequate use of video channels, and to determine the contributions thus made to the improvement of education.

"2. To develop and test practical and economic equipment assemblies and methods for recording appropriate parts of courses on sound films as an approach to reducing the cost of instruction and to demonstrate possibilities for extending the influence of good instruction to other school systems and institutions.

"From our discussions it is my further understanding that an effort will be made throughout 1955-56 to develop a generalized 'grid' or chart of all the possibilities for methods of instruction and objectives of courses that would have to be tried out in order to determine whether television can be used for instruction in most of the courses offered in the University. Obviously, it is certainly not necessary to demonstrate for each course in the University or even for one course in each department to determine whether or not television instruction can be used on a wide basis throughout an institution.

"We have assumed in all of our discussions that as a course is offered over television an effort is made to improve the course rather than merely offer it as it has been offered in the classroom previously. For this purpose you have indicated that the staff time released because of the use of television would be utilized for the purpose of improving the courses.

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[1] Quotation from letter written by the Vice-President of the Fund for the Advancement of Education to the Director of the project.

"This project and the support from the Fund grow out of a common interest of the Pennsylvania State University and the Fund for the Advancement of Education in the critical shortage of teachers necessary to offer instruction to the swelling enrollments in colleges and universities under methods usually followed. We have a common concern also in providing better instruction. It is our hope that the use of television may make it possible for the very best teachers on the campus to extend their instruction to an ever-growing body of students.

"We have agreed, too, in carrying forward the project that it would be appropriate to set up an advisory committee of eight to ten persons and that you will proceed to do so. It will be the function of this committee to offer suggestions and to stimulate interest outside the Pennsylvania State University in the possible use of television instruction in case the demonstrations at Penn State are successful."

Another difficult but exciting year of work with instructional television has already begun. The risks and challenges are of sizeable dimensions. The possibilities are very favorable for making significant contributions to the solutions of major problems confronting higher education in the United States.

The expected potentialities of instructional television relate most directly to the calculated future increases of student enrollment in colleges and universities, the anticipated limitations of faculties and academic facilities, and the urgent need to maintain or improve the quality of instruction.

The solutions to some practical and operational problems can be closely approximated through careful developmental work and realistic procedures, thereby a basis of evidence can be made available for those who must make practical decisions about university instruction. There are other persisting practical and basic research problems for which *final solutions* cannot be expected. Vigorous and continuing research on a wide range of problems of the potentialities and limitations of instructional television would seem to be necessary and justifiable as colleges and universities apply this new instrumentation as *one* means of solving *some* of the problems related to the expanding responsibilities of higher education in America.

Selected Bibliography

1. **Allen, M. Robert.** *Quartermaster training command, educational-television study.* Fort Lee, Va.: Quartermaster School, Quartermaster Training Command, U. S. Army, 1954.

   The purpose of this study was to determine whether a short program of instruction through television would be as effective and as acceptable to Quartermaster ROTC students as is classroom teaching. The study was done by Army Quartermaster personnel in cooperation with the University of Houston and station KUHT-TV. A total of 107 subjects were used with 47 students in the experimental group and 60 in the control group divided by random selection. Four one-hour lessons on Army Food Service Activities taught by the same instructor provided the course content.

2. **Boehm, William R.** *Report of an evaluation of the U.S. Naval Academy educational television system.* Annapolis, Md.: U. S. Naval Academy, 1954.

   A carefully designed study to evaluate the Academy's television system in the educational process. Two assigned lessons in the first class course in electronics provided content for the test lessons. In a total population of 840 second term midshipmen, half received televised instruction, the other half regular instruction for the first lesson. Groups were then reversed so as to receive alternate treatment for the second test. All groups were given a pretest, an achievement test after the lesson and a test of retention six weeks later. Results and conclusions are included in the report.

3. **Conrad, Lawrence H.** *Educational television moves forward.* Montclair, N. J.: New Jersey State Teachers College, 1952.

   Presents an account of what is considered to be the first full day of educational television. The New Jersey State Teachers College at Montclair produced eight programs of lesson material planned by public school teachers for their own classes. These eight lessons were transmitted over UHF Channel 54 to specially prepared television receivers in thirteen public schools in the towns of Bloomfield and Montclair, where they were used as part of the regular school work for the day by the classes for which they were designed. Deliberately planned units of education by television were carried on in these various schools in the morning and afternoon of April 30, 1952.

4. **Crile, Lucinda.** *Some findings from television studies.* Extension Service Circular 490. U. S. Department of Agriculture, 1953. Mimeographed.

   A well annotated bibliography containing 31 studies treating such subjects as education by television, techniques of production and programming, and the television audience.

5. **Cumming, William Kenneth.** Television programs that teach. In, *This is educational television.* Ann Arbor, Michigan: Edwards Brothers, Inc., 1954. Pp. 114-150.

   Presents a summary of some research in the area of instruction by television. Remainder of chapter devoted to a discussion of extra-school television programming (non-resident courses) and intra-school programming (resident instruction) in colleges and universities.

6. **Dowell, E. C.** *An experiment in training by television.* Project 53-32. Keesler Air Force Base, Miss.: 3380th Technical Training Group, USAF, 1953. Mimeographed.

   Presents a report on a study designed to evaluate the effectiveness of closed-circuit television as an instructional medium in comparison with conventional methods of presentation and, as a secondary objective, to investigate the feasibility of making kine-photo recordings suitable for use as training films in specific courses. Two matched groups of 120 trainees each were given a segment of an Electronics Fundamentals course, one group receiving conventional instruction, the other television instruction. Two instructors were alternated with the two groups and the two methods. The criterion measure was a 50-item multiple choice achievement test. This was administered as a pretest to a third group of students.

7. **Educational Television Research Fact Sheet,** National Association of Educational Broadcasters, Urbana, Illinois.

   The fact sheet comprises a series of reports on television research in the following specific areas: the effectiveness of television (as a teaching tool), production principles, bibliography, audience studies, content and impact.

8. **Evans, Richard I., Roney, H. Burr, McAdams, Walter J.** An evaluation of the effectiveness of instruction and audience reaction to programming on an educational television station. *J. Appl. Psychol.* In press.

   Describes a study conducted by University of Houston psychologists to determine the effectiveness of an elementary psychology and an elementary biology course on KUHT-TV as compared to the same course taught in a conventional manner. Some attention was given to a small study of the Houston station audience.

9. **Finn, James D.** Television and education: a review of research. *Audio-Visual Communication Review,* Spring, 1953. Pp. 106-126.

   Contains a comprehensive review of educational television organized in terms of general social effects, content analyses, educational effects and technical problems. After reviewing the existing published research certain general conclusions are drawn by the author.

10. **Fritz, M. F., Humphrey, J. E., Greenlee, J. A., Madison, R. L.** *Survey of television utilization in army training.* Technical Report SDC 530-01-1. Port Washington, L. I., New York: Special Devices Center, U. S. Navy.

    This is a report of a study undertaken by Iowa State College for the Special Devices Center, Office of Naval Research. The object was to interpret previous findings and experience in terms of direct application to army training problems. The work was done by reviewing existing literature, by observing military installations and teaching practices, and by analyzing data on the effectiveness of television made available by the Signal School at Fort Monmouth.

11. **Husband, Richard W.** Television versus classroom for learning general psychology. *Amer. Psychologist,* 1954, 9(5). Pp. 181-183.

    Describes nature and reports results of a study conducted by Iowa State College where a course in psychology was taught by the author and presented as a series of 30-minute programs over station WOI-TV and viewed also by a studio class and by a class-room group viewing the kinescope recordings with an additional 20 minutes of discussion. Two additional classes taught by the author in the conventional manner were included in the comparison.

12. **Institutions with closed-circuit television facilities.** Joint Committee on Educational Television, Washington, 1954. Mimeographed.

Contains, in addition to a list of institutions with closed-circuit facilities, information received in response to a survey conducted by the Joint Committee on Educational Television on the nature and use of these facilities.

13. **Jackson, R.** *Visual principles for training by television.* Technical Report SDC 20-TV-2. Port Washington, L. I., New York: Special Devices Center, U. S. Navy.

Discusses the testing of one hundred and five training devices made by the Special Devices Center for visibility on television. A series of 31 visual principles was evolved. These principles were grouped into eight general areas, among which were included organization, contrast, movement, surfaces, dimensionality, color and size.

14. **Kanner, Joseph H., Runyon, Richard P., Desiderato, Otello.** *Television in army training: evaluation of television in army basic training.* Technical Report HumRRO 14. Washington, D. C.: Human Resources Research Office, George Washington University, Dept. of the Army, 1954.

A study to obtain a measure of the relative teaching effectiveness of television instruction utilizing army basic training subject matters. Fourteen hours of the basic training course were selected and parallel televised instruction was prepared. Comparisons were made between television and regular instruction, between kinescope recordings and regular instruction, between relative effects of television and regular instruction, and between low and high aptitude on learning and retention effects of television. About 12,000 basic trainees matched for aptitude on basis of Area I scores were involved in the research. Achievement tests were given immediately after instruction and again a month later.

15. **Kelly, George A., Conrad, Lawrence H.** *Report on classroom television.* Montclair, N. J.: New Jersey State Teachers College, 1954.

This is an account of a study sponsored by the Fund for the Advancement of Education conducted at Montclair State Teachers College, the purpose of which was to determine what constitutes the good television teacher and to explore the educational feasibility of televising outstanding teachers presenting units of instruction which form a part of the school curriculum. Selection and evaluation of teachers, analysis of televised teaching techniques, and preparation and presentation of nine televised lessons in an American history series with accompaying results are subjects treated in the report.

16. **Lewis, Philip.** Closed-circuit TV, new tool for teachers. *Chicago School Journal,* 1953, 35(3-4). Pp. 60-75.

Discusses the Chicago Teachers College program of experimentation and results to date in the use of the closed-circuit vidicon system with the purpose of utilizing television as a practical aid to instruction, in magnifying objects and demonstrations to make them visible to large numbers of students.

17. **Make a dress—TV.** State College of Agriculture. Agricultural Extension Service. Ames, Iowa; Iowa State College, 1953.

Contains an account of a course in dressmaking presented twice a week for five weeks over WOI-TV during February of 1951. Personal interviews were held with a stratified random sample of respondents drawn from the names of all women who had enrolled before the series began. The data based on 364 respondents are included.

18. **McKeachie, W. J.** Teaching psychology on televison. *Amer. Psychologist,* 1952, 9. Pp. 503-506.

    Contains an account of a televised course in psychology taught by the author over station WWJ-TV, Detroit. Audience interest and response, goals and course content as well as production procedures and techniques were discussed. No evaluation of the effectiveness of the course was made.

19. **Millis, J. S.** Formal education by television. In, C. V. Newsom, (ed.), *A television policy for education.* Washington, D. C.: American Council on Education, 1952. Pp. 35-51.

    Presents the program of televised instruction offered by Western Reserve University in the fall of 1951. Courses for credit included Elementary Psychology, 3 semester hours, and Comparative Literature, 2 hours. A comparison of raw scores was made on the final examination for students enrolled in the television course and students who had taken the course in the classroom on the campus.

20. **Rock, R. T., Duva, J. S., Murray, J. E.** *The comparative effectiveness of TV instruction in training naval air reservists.* Technical Report SDC 476-02-S2. Port Washington, L. I., New York: Special Devices Center, U. S. Navy, 1951.

    This is a report on a study done by Fordham psychologists for the Special Devices Center, Office of Naval Research, to determine the comparative effectiveness of live television, kinescope recordings projected as motion pictures, and conventional classroom instruction and also to determine the acceptability of televised instruction. Approximately 700 naval air reservists in three groups of from 100 to 120 men were instructed by television by kinescopes, and by conventional methods in two series of eight lessons, one a refresher course for officer pilots and the other a basic training course. Pre-tests and post-tests were used to measure learning.

21. **Rock, R. T., Duva, J. S., Murray, J. E.** *Training by TV—a study in learning and retention.* Technical Report SDC 476-02-3. Port Washington, L. I., New York: Special Devices Center, U. S. Navy.

    In this study, also conducted by Fordham psychologists for the Navy, the problem was whether television could be used effectively to teach army reservists, and whether students taught by television could remember what they learned. Eight one-hour television lessons titled "Command Post" which dealt with command and organizational problems in time of attack were broadcast to 160 groups including some 3,000 reservists in ten major cities. Pre-tests were given before the course, and scores on those tests were compared with test results when the course had been completed.

22. **Shimberg, Benjamin.** *Effectiveness of television in teaching home nursing.* Research Bulletin 54-19. Princeton, N. J.: Educational Testing Service, 1954.

    Reports the results of the Educational Testing Service's conducted study for the American Red Cross to determine whether television could be used effectively to teach home nursing to adults viewing the programs at home, and how the results of such instruction compared with the results of conventional classroom teaching.

23. **Teaching by television.** The Signal School, Fort Monmouth, New Jersey, 1953. Mimeographed.

A report of a study to determine the extent to which television could be used as an aid in presenting the various technical subjects taught in the School. Results of instruction in three sub-courses of a technical content nature—principally radio and radar—were compared with standard classroom results. Evaluation was made in terms of pre-tests and post-tests, questionnaires, subjective observation and discussion.

24. **Thomas, K.** Closed-circuit TV—a teaching tool. *Research Tools* (Special Devices Center). Pp. 43-58.

Some practical and concrete suggestions are given for using television for purposes of instruction. Methods of preparing a television lecture, applications of closed-circuit television and television recordings are discussed.

25. **Udell, Gene.** The uses of closed-circuit television for instruction. Doctoral dissertation in progress. Teachers College, Columbia University, 1955.

This dissertation was not completed at time of writing this bibliography. Tentative topics will include: Description of basic units of closed-circuit television equipment, description of uses of closed-circuit television in non-instructional situations, description of uses in instructional situations, possible uses not now in current practice, and research and opinion about closed-circuit television.

26. **Williams, D. C.** Mass media and learning—an experiment. *Explorations* (University of Toronto, Canada), 3, 1954. Pp. 75-82. Paul, J., Ogilvie, J. Mass media and retention. *Explorations,* 4, 1955. Pp. 120-123.

These reports treat two related experiments conducted at the University of Toronto under a Fund for the Advancement of Education grant. One hundred and eight undergraduates were given a lecture by the same teacher on an unfamiliar topic. One-fourth received the lecture on television, one-fourth on radio, one-fourth in the studio where lecture originated and one-fourth read the same lecture mimeographed with some words capitalized for emphasis. Results of experiment are given and conclusions made.

APPENDICES

Appendix I

List of Equipment Used in a Dual Camera Moderate Cost Television System (Chemistry System, Osmond Laboratory)

A. *Basic Camera Chain*

2 Dage Professional Cameras Model 300-D
2 Camera Control Units Model 700-D
3 Power Supplies Model 800-A
1 Synchronizing Generator Model 400-B
1 Switching and Fading Unit Model 500-B

Plus all equipment inter-connecting cables, two tripods and dollies, three monitoring headsets, and three lenses for each of the two cameras (½", 1" and 2")

Package Price $13,000.00

B. *Supplementary Items*

1 Dage Audio-Video Mixer	365.00
1 Dage Distribution Amplifier 250-A	200.00
2 3" Lenses f2.8	176.00
1 Dage 14" Monitor	399.00
1 Electro-voice Microphone, Model 647, low impedance (for instructor)	47.00
2 Hi-hat Table Mounts for Cameras	36.00

C. *Additional Items in Psychology System*

1 Holmes 16mm TV Film Projector	2,385.00
1 Dage Multiplexer for Film Projection	245.00
1 Electro-voice Microphone Model 654 (for classroom pick-up)	56.00
1 Stromberg Carlson Audio Mixer AV38	210.00

D. *Coaxial Cables and Receivers*

Estimated cost of coaxial cable and connectors for one system (6 rooms)	200.00
Receivers 24" Westinghouse Model H875T24C, each	249.00
Bridging transformer and parts needed for modification of each receiver	25.00
Stand for each receiver	20.00

E. *Lighting Units (For One System)*

4 8" Fresnel Lens Spot Lights (Kleigl 44N8TVG) @ 70.35	281.40
3 18" Scoops (Kleigl TV1155G) @ 44.55	133.65
1 Connector batten strip for floodlights (Kleigl 2432G)	83.50
4 Barn Doors for 44N8TVG @ 10.00	40.00

Lamps for above units

3 1500/IF @ 5.00	15.00
4 2M/G48/8SP @ 10.75	43.00

Appendix 2

LIST OF EQUIPMENT USED IN LOW COST (SINGLE CAMERA) SYSTEM

1 Dage Model 60-A Camera with turret and cables	$1,064.50
1 Dage 14" Monitor	399.00
3 Lenses (½", 1", 2")	285.00
1 Quickset Tripod	35.00

If it were desired to supply a picture and sound to several receivers the following additional items would be needed:

1 Dage Audio-Video Mixer	365.00
1 Dage Distribution Amplifier	85.00
1 Microphone, Electro-voice Model 647	47.00
Standard receivers as desired, each	249.00

Appendix 3

LIST OF TEST EQUIPMENT

1 Tektronix Oscilloscope Model 524-D	1,180.00
1 Vacuum Tube Voltmeter (RCA Junior Volt Ohmist)	47.50
1 Volt-Ohm Meter (Simpson Model 260)	38.00
1 NARTB TV Test Chart	4.00
Miscellaneous Tools	25.00

Appendix 4

LIST OF PERSONNEL PARTICIPATING IN THE INSTRUCTIONAL TELEVISION PROJECT AT THE PENNSYLVANIA STATE UNIVERSITY AUGUST 1954–JULY 1955

DIRECTOR	C. R. Carpenter
ASSOCIATE DIRECTOR	L. P. Greenhill

HEADS OF PARTICIPATING DEPARTMENTS:

Chemistry–W. C. Fernelius
Psychology–C. R. Carpenter

STEERING COMMITTEE:

A. O. Morse, Provost *(Ex officio)*
L. Dennis, *Assistant to President*
C. R. Carpenter
W. C. Fernelius

GENERAL RESEARCH COORDINATOR	C. J. McIntyre
RECORDER AND LITERATURE SURVEY	D. Sherk

PARTICIPATING INSTRUCTORS:

Chemistry 2

G. W. Smith, *Professor,* Head Freshman Chemistry
C. G. Haas, *Assistant Professor*
T. Wartik, *Assistant Professor*

Psychology 2

K. R. Smith, *Professor*
J. F. Hall, *Associate Professor*

Psychology 17

C. R. Adams, *Professor*

DESIGN, TESTS AND MEASUREMENT COMMITTEE:

R. Watkins
C. J. McIntyre
J. Grosslight
S. Siegel
R. P. Barthol

OPERATION OF SYSTEMS:

Sparks System

L. F. Kepler, In charge
D. Sherk
J. Murnin
P. Myers
H. E. Nelson

Osmond System

L. P. Greenhill, In charge
J. Driscoll
D. Sherk

STUDENT CAMERA OPERATORS:

K. Stern
C. Folkers
S. Walcott
S. Greenspun
M. Slakoff

STUDENT ENGINEERING ASSISTANTS:

F. Stauffer
L. Matter
W. Pohts
R. McClaine
J. Raleigh

PROJECT SECRETARY:

E. Beittel

It should be noted that most of the above people worked in a part-time capacity on the project.

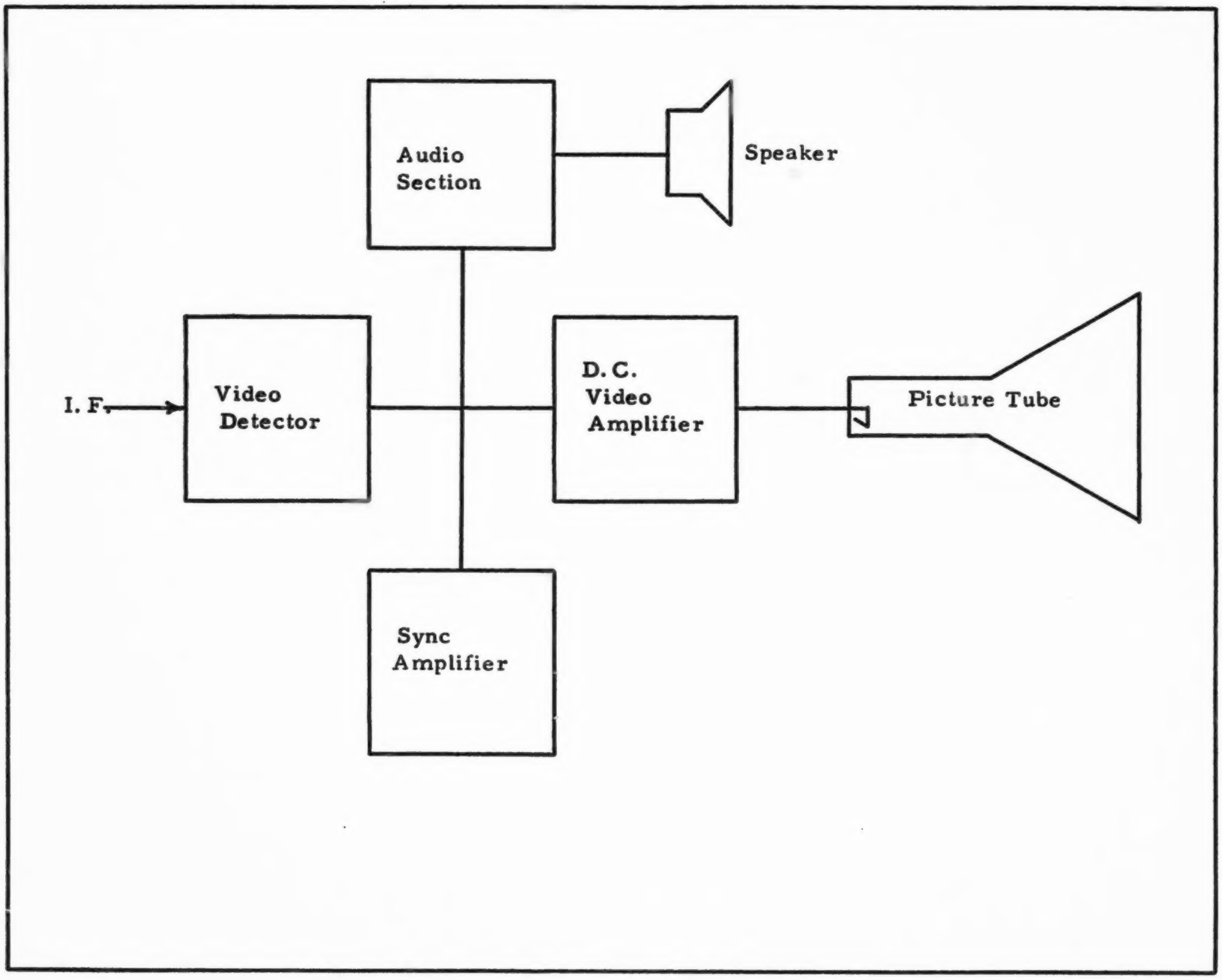
Audio Section
Speaker
I. F.
Video Detector
D. C. Video Amplifier
Picture Tube
Sync Amplifier

Figure 14. Block Diagram of Unmodified Receiver

Appendix 5

MODIFICATIONS TO RECEIVERS FOR ACCEPTING VIDEO FREQUENCY PICTURE AND R.F. SOUND

The block diagram of a typical television receiver is shown in Figure 14. Only that portion of the receiver requiring modification is shown.

Modifications consisted of removing the inputs to the video amplifier and synchronizing amplifier from the video detector and bridging these inputs across the coaxial distribution line. A blocking condenser and small R.F. choke (R.F. choke prevents R.F. carrier from entering video section) had to be added to these inputs which in turn required that the a D.C. restorer and some modifications to the sync circuit be

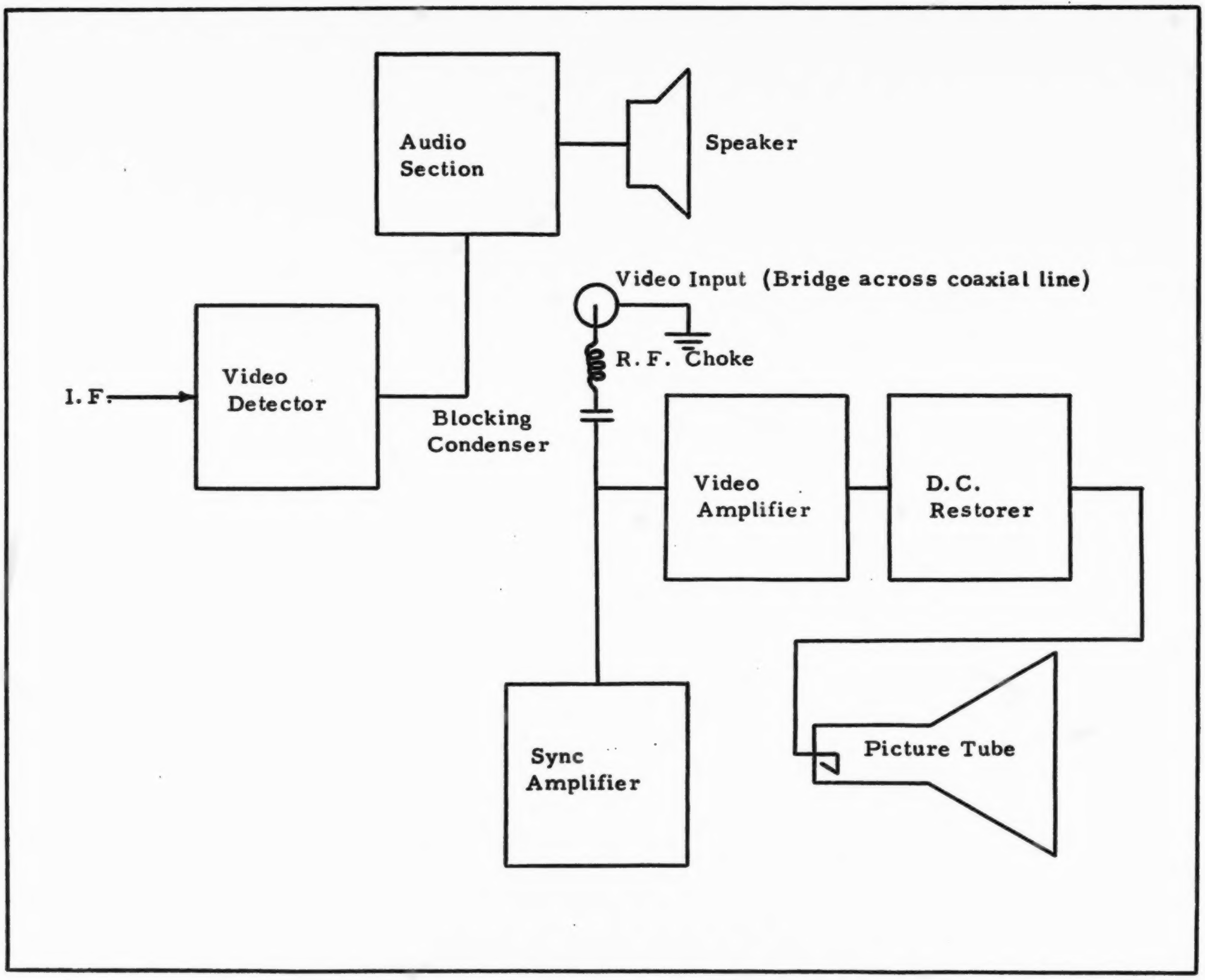
Audio
Section
Speaker
Video Input (Bridge across coaxial line)
R.F. Choke
I.F.
Video
Detector
Blocking
Condenser
Video
Amplifier
D.C.
Restorer
Picture Tube
Sync
Amplifier

Figure 15. Block Diagram of Modified Receiver

included. From experience, it was found that the D.C. restorer did not add greatly to the final results and could have been omitted. In some model receivers (four models of Westinghouse receivers were employed) a change in the cathode bias resistor was necessary in the video amplifier stage.

On each receiver the antenna input was bridged across the coaxial line with a bridging transformer. The sound thus was handled by the receiver in the usual manner. The bridging transformer originally consisted of a network of resistors. It was necessary to add a small condenser in series with this network to block out the D.C. level on the coaxial cable.

A block diagram of a modified receiver is shown in Figure 15.

Appendix 6

(F Scale)

Opinion Questionnaire

The following are statements with which some people agree and others disagree. Please mark each statement in the left-hand margin according to your agreement or disagreement, as follows:

+1 = slight support, agreement
+2 = moderate support, agreement
+3 = strong support, agreement

–1 = slight opposition, disagreement
–2 = moderate opposition, disagreement
–3 = strong opposition, disagreement

______ 1. Human nature being what it is, there will always be war and conflict.

______ 2. Obedience and respect for authority are the most important virtues children should learn.

______ 3. No weakness or difficulty can hold us back if we have enough will power.

______ 4. Science has its place, but there are many important things that can never possibly be understood by the human mind.

______ 5. Every person should have complete faith in some supernatural power whose decisions he obeys without question.

______ 6. When a person has a problem or worry, it is best for him not to think about it, but to keep busy with more cheerful things.

______ 7. A person who has bad manners, habits, and breeding, can hardly expect to get along with decent people.

______ 8. What the youth needs most is strict discipline, rugged determination, and the will to work and fight for family and country.

______ 9. Some people are born with an urge to jump from high places.

______ 10. Nowadays when so many different kinds of people move around and mix together so much, a person has to protect himself especially carefully against catching an infection or disease from them.

______ 11. An insult to our honor should always be punished.

______ 12. Young people sometimes get rebellious ideas, but as they grow up they ought to get over them and settle down.

______ 13. What this country needs most, more than laws and political programs, is a few courageous, tireless, devoted leaders in whom the people can put their faith.

______ 14. Sex crimes, such as rape and attacks on children, deserve more than mere imprisonment; such criminals ought to be publicly whipped, or worse.

______ 15. People can be divided into two distinct classes: the weak and the strong.

______ 16. There is hardly anything lower than a person who does not feel a great love, gratitude, and respect for his parents.

______ 17. Some day it will probably be shown that astrology can explain a lot of things.

______ 18. Nowadays more and more people are prying into matters that should remain personal and private.

______ 19. Wars and social troubles may some day be ended by an earthquake or flood that will destroy the whole world.

______ 20. Most of our social problems would be solved if we could somehow get rid of the immoral, crooked, and feebleminded people.

______ 21. The wild sex life of the old Greeks and Romans was tame compared to some of the goings-on in this country, even in places where people might least expect it.

______ 22. If people would talk less and work more, everybody would be better off.

______ 23. Most people don't realize how much our lives are controlled by plots hatched in secret places.

______ 24. Homosexuals are hardly better than criminals and ought to be severely punished.

______ 25. No sane, normal, decent person would ever think of hurting a close friend or relative.

______ 26. Familiarity breeds contempt.

______ 27. It is essential for learning or effective work that our teachers or bosses outline in detail what is to be done and exactly how to go about it.

______ 28. Some leisure is necessary, but it is good hard work that makes life interesting and worth while.

______ 29. Books and movies ought not to deal so much with the unpleasant and seamy side of life; they ought to concentrate on themes that are entertaining or uplifting.

______ 30. When you come right down to it, it's human nature never to do anything without an eye to one's own profit.

Appendix 7

PERSONAL RELEVANCE SCALE

Instructor ____________
Room No. ____________
(Where your class normally met)

These questions are *not* a part of the examination and have no bearing on your grade. When you have finished them, tear off this sheet and place it on the table when you leave. Be sure to write at the top the name of your instructor and the number of the room in which you took the course.

FOR ALL SECTIONS

Instructions: Please circle the alternative which best completes each statement.

I. As far as using the information in this course is concerned,
  a. I think I'll be able to use it very soon.
  b. I think I'll probably be using it in the near future.
  c. I think I'll find a use for it sometime.
  d. Right now I don't see any use for it.
  e. I don't think I'll be able to use it.
  f. I won't ever be able to use it.

II. If I have a chance in the future to find out more about the subject of this course,
  a. I surely will try to.
  b. I think I'd like to.
  c. I may be interested in doing so.
  d. I doubt if I would be interested.
  e. I wouldn't be very interested.
  f. I wouldn't have anything to do with it.

III. The information in this course
  a. is right in line with my main interests.
  b. has to do with things that interest me.
  c. is somewhat of interest to me.
  d. is neither interesting nor uninteresting, as far as I'm concerned.
  e. is not very interesting to me.
  f. is of no interest to me.

IV. To learn what was in this course
  a. seems absolutely necessary to me.
  b. seems rather valuable to me.
  c. would be a good thing to do.
  d. is fairly important I guess.
  e. is of no particular importance to me.
  f. is more or less a waste of my time.

V. In my future work, the information presented in this course
  a. will be of great value to me.
  b. will probably help me a lot.
  c. should be of some value to me.
  d. will not be very useful to me.
  e. will be of little use to me.
  f. will be of no use to me.

VI. Now that I've taken this course,
  a. I certainly am glad I took it.
  b. I think it was probably a good course for me to take.
  c. I guess it was worth taking.
  d. I have no opinion about it, one way or the other.
  e. I think it was dull and boring.
  f. I think it was a waste of my time.

VII. If I were given the opportunity to take an advanced course similar to this course,
  a. I would jump at the chance.
  b. I would like to take it.
  c. I guess I would want to take it.
  d. I would hesitate to take it.
  e. I would not want to take it.
  f. I definitely would not take such a course.

VIII. I think this course covered a subject-area that
  a. I definitely ought to know about.
  b. will probably benefit me.
  c. might do me some good sometime.
  d. has no particular value for me.
  e. will probably not benefit me.
  f. I definitely do not know about.

IX. The subject matter of this course was
  a. interesting, and I'll probably use what I've learned.
  b. uninteresting, although it is important for my future.
  c. uninteresting, but it could be useful.
  d. interesting, but I don't think I'll use it very much.
  e. interesting, but I'll probably never use it.
  f. uninteresting, and I'll probably never have any use for what I've learned.

X. As far as all the courses I have taken are concerned, this course is
  a. the most useful one I have ever taken.
  b. among the most useful I have ever taken.
  c. fairly useful.
  d. not very useful to me.
  e. quite useless.
  f. the most useless course I have ever taken.

Appendix 8

***Example of:* STUDENTS' REACTION SCHEDULE**

As you all know we are interested in evaluating the feasibility of television as an educational tool for use in university instruction. There are many factors and viewpoints which must be considered. One of the most important considerations is that of students' reactions to taking a university course by television. In order to provide a record of your reactions, and to help us improve the course as we go along, from time to time you will be asked to complete several brief questionnaires like this one.

Please consider each question carefully and write your responses as fully and honestly as you can.

1. Do you think you are learning as much over television as you would have learned in a conventionally taught course with the same instructor?

______ much more
______ a little more
______ about the same
______ a little less
______ much less

Why?

2. Do you think the course is more or less *interesting* than it would have been as taught by conventional methods and procedures?

______ much more interesting
______ a little more interesting
______ about the same
______ a little less interesting
______ much less interesting

Why?

3. From your point of view, please compare television and conventional instruction:

Principal advantages of television

Principal disadvantages

4. In your opinion, how much do you miss not being able to participate in class discussions or ask questions?

______ a great deal
______ a little
______ not at all

Why?

5. One of the reasons given for research findings which have shown television instruction to be more effective than conventional instruction is that students viewing television have fewer distractions and can concentrate better on what is being taught. Do you:

______ agree strongly
______ agree somewhat
______ disagree somewhat
______ disagree strongly
______ have no opinion

6. What improvements in transmission of sound or picture, or of viewing conditions do you think should be made in the television course you are taking? Indicate after each whether you think it is urgent, or desirable but not particularly urgent.

7. Do you feel that you know your instructor in the course about as well as you know your other instructors whom you have had for an equal time?

______ not as well
______ about as well
______ better
Why?

8. Additional comments:

Appendix 9

Example of: **ROOM OBSERVERS' REPORT FORM**

Observer's Name ______________________ Room No. ________ Day ________

Date ______________ Hour ________ Instructor's Name ______________

Course ______________

I. Equipment Deficiencies (Please describe. How long did it last?)

1. Picture
2. Sound
3. What did you do about this?
4. Was there any apparent student reaction? What?

II. Suggestions for improving the presentation

(Relate material presented to possible improvement—e.g. better or longer close-ups, use of slides, graphs, film clips, etc.)

III. Observation of students

In relation to your usual experience with students, do these appear to be better or worse motivated, more or less interested, as evidenced by sleeping, talking, note-taking, etc. Also, please record comments or questions by students which you think are pertinent to the evaluation.

IV. Test items

Psych. 2. Try to write at least two per lecture.
Chem. 2. Any ideas you may have for pictorial items relevant to the demonstrations.

V. Other comments: